Market Assessment for Poplar Products

VOLUME I of 3

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The responsibility for the content of this report is the consultant's alone, and the conclusions reached herein do not necessarily reflect the opinions of those who assisted during the course of this investigation or the Federal and Provincial governments which funded the study.

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INTRODUCTION

Canada possesses one of the most abundant and accessible forest resources in the world. Almost 40% of Canada is covered by forest and forests are part of the land cover, to a greater or lesser extent, in all regions of the country. Since the early 1900's, industry based on this resource has been a major contributor to Canada's economic growth. In 1981, almost 15% ($1.9 billion) of the total value of manufacturing in Canada was derived from the forest-based sector. The broad distribution of Canada's forest resource makes the forest products industry an important industrial component of all provincial economies. The industry is particularly important to British Columbia since forest products account for the largest share of provincial output, and to Alberta where utilization of renewable resources will become increasingly important in the future. Despite the recognized importance of the forest resource to Canada and despite the fact that Canadian log extraction and processing techniques are amongst the most advanced in the world, a major component of Canada's forest resource, the poplar species*, remains virtually untouched.

Estimates show that poplar constitutes 54% (1.9 billion cubic metres) of Canada's total hardwood resource and almost 10% of Canada's total merchantable forest resource. The national allowable annual poplar cut has been established at 42 million cubic metres but the actual annual cut normally amounts to less than 5% of the allowable. For Alberta and B.C., which together contain 47% (870 million cubic metres) of Canada's poplar, the utilization factor is even lower, with the actual cut accounting for less than 1% of the total allowable harvest of 16 million cubic metres.

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* Although several species of poplar occur in Canada, the most common in western Canada and the species included in the scope of this study are: P. tremuloides (trembling aspen), P. balsamifera (black or balsam poplar), and P. trichocarpa (black cottonwood).

There are many reasons for this low level of utilization but the principal reason in western Canada has been the availability of large diameter, high quality, easily accessible softwood species. The softwood resource of both Alberta and B.C. is now, however, for all practical purposes, approaching the maximum level of economic utilization. This factor, combined with declining softwood log quality and increasing distance from forest to plant, has focused attention on the under-utilized poplar resource. As a result, over the past decade or more, many significant poplar-based research and development programs have been undertaken. Virtually all of these, however, have been directed to resolving technical problems, whereas the question of the marketability of poplar products has received peripheral attention only. Recognizing this deficiency, the governments of Canada, Alberta and B.C. agreed to share the funding of a study of the markets for poplar-based products. Accordingly, acting through a committee of representatives of the Department of Regional Economic Expansion, Ottawa, Edmonton, and Victoria; the Department of Energy and Natural Resources, Edmonton and the Ministries of Forests and Industry and Small Business Development, Victoria, Carroll-Hatch (International) Ltd., (CHI) of Edmonton and Vancouver, was selected to conduct this market evaluation.

The terms of reference were established in a letter of June 8, 1982 and were subsequently finalized in several meetings held between the committee and CHI.

The scope of the study, as defined by the terms of reference, was very broad and included any product which could possibly be produced from poplar. The categories of these products were defined as follows:

(a) energy, chemicals and animal feed,

(b) pulp, paper and related products such as pulp logs and chips,

(c) dimension lumber and solid wood specialty products such as interior finishing and furniture blanks,

(d) composite wood products such as veneer, plywood, laminated veneer lumber, waferboard, oriented strand board, fibreboard, hardboard, coreboard and thin particleboard.

It should be noted that several of the above categories actually represent a family of products rather than a single product and, with that understanding, the broad scope of the study becomes apparent.

In addition to the wide range of products to be evaluated, the terms of reference called for an analysis of the potential market offered by all world regions for each of the selected product categories. It is obvious that conducting an in-depth market analysis for every product in every region would require a budget far in excess of that allocated to this study and, in fact, such an analysis is not considered necessary to achieve the study objectives. These objectives may be summarized as: 1. the identification of potential markets for poplar-based products; 2. the most effective method for servicing those markets; 3. what action, if any, should be taken by government agencies to assist the private sector to exploit the identified market opportunities.

Although the terms of reference specified that the scope of the study should be confined solely to the markets for poplar-based products, in most cases, the dominant market constraints were found to be those imposed by economic and technical factors and, of necessity, these factors had to be discussed. Therefore, reviews of these "non-market" factors been included in the appropriate sections of this report.

Material presented has been obtained from a variety of sources, including previously published government and private agency reports, analyses, and statistical data. The literature assembled for analysis is considered to be a comprehensive collection of relevant national and international publications and has been extensively reviewed relative to the objectives of this report. In addition, interviews were conducted in the major potential market areas of North America, western Europe, Japan, Korea, Taiwan, Hong Kong and Singapore. Interviewees included forest products manufacturers, agents, distributors and end-users. Transportation companies and relevant government agencies, in all potential market areas were also interviewed. The broad scope of the study introduced a degree of unavoidable repetition in the report, but this has been kept to the minimum possible.

For convenience, the report has been separated into three volumes:

Volume I	Executive Summary
Volume 2	Pulp and Paper Pulpwood Wood Chips Chemicals Animal Feed
Volume 3	Lumber Panel Products Energy

This volume, Volume I, presents a summary of the report and, as such, contains a minimum of statistical data or reference material to support statements made herein. Confirming documentation is included in the appropriate sections of Volumes 2 and 3. The intent in this volume is to present a comprehensive but brief synopsis of the major findings, conclusions arising from those findings and suggested courses of action.

It is important to reiterate that the study, on which this report is based, was wide ranging and could not, in any sense, be considered a definitive or in-depth analysis. Therefore, a degree of uncertainty must be accepted in relation to the conclusions which will be discussed in the following sub-sections. Despite this caveat, however, the conclusions reached and the suggestions made are considered to possess an acceptable degree of reliability.

SYNOPSIS OF REPORT

Of the wide range of products studied, only a small but important group appears to offer the opportunity for immediate, economically sound, market development. The remainder ranges from products requiring specialized conditions for development to those with a very doubtful degree of viability even on a long-term basis. Accordingly, a listing has been prepared which, in general, places products in decreasing order of priority for more detailed analysis. In this listing, shown below, the products included in category A are considered to offer the best potential and those in category B offer minimal, declining to nil, opportunity for economic development within the forseeable future. It should be noted, however, that all products, regardless of category, require a site-specific, detailed feasibility study prior to development decisions being taken.

PRODUCTS AND MARKETS IN ORDER OF DECREASING DEVELOPMENT OPPORTUNITY

Category	Product	Market
A	Selected Pulp and Paper Products - bleached sulphate market pulp - market mechanical pulp - newsprint - printing and writing paper	North America Japan Western Europe
	Medium-Density Fibreboard	Canada Japan Southeast Asia EEC
	Thin Particleboard	North America Japan Southeast Asia
	Lumber	North America Japan Southeast Asia Western Europe

Category	Product	Market
B	Wood Chips	Japan
	Standard Particleboard	North America
	Energy	North America
	Waferboard	North America Japan
	Veneer and Plywood	North America
	Hardboard	North America
	Pulpwood	North America Japan
	Animal Feed	North America
	Chemicals	North America

The foregoing listing should not be interpreted as a statement that, for example, 100% aspen pulp could be produced and sold economically into western Europe, but rather that aspen pulp constitutes one of the most promising products for more detailed study and that the study should concentrate on markets in North America, Japan and western Europe in that order. Animal feed and chemicals are considered to be the least attractive for further concentrated study.

A summary of the rationale on which the categorization has been based is presented in the following sub-sections. Each product is discussed in the same order as that presented in the table. As noted previously, detailed discussions of each product and market are presented in Volumes 2 and 3.

PRODUCT AND MARKET SELECTION RATIONALE

Selected Pulp and Paper Products

On the basis of the poplar species found in Alberta and B.C., and without considering the volume and quality of fibre available at any specific location, but taking into account recognized market constraints, the following pulp and paper products have been identified as offering the best potential for successful development.

- bleached sulphate market pulp,
- market mechanical pulp,
- newsprint,
- printing and writing paper.

The remaining pulp and paper products either do not appear to be technically viable or do not meet market-related criteria in the near future.

Only about 20% of the world's total wood pulp production is market pulp, defined as wood pulp produced for sale in open markets rather than for captive use. Most pulp is made and consumed either at the same location or transferred to affiliated mills. The flexibility possessed by integrated pulp and paper mills to change from captive to market pulp production and from one grade to another (e.g., from hardwood to softwood), makes it impossible to distinguish clearly between market pulp and captive pulp production. This flexibility also encourages instability in markets and is one of the principal causes of price volatility.

Bleached Sulphate Market Pulp

Bleached sulphate pulp, made from hardwoods, is currently utilized in a wide variety of paper and paperboard products, especially where high strength is not a primary consideration. Because of its inherent characteristics, short fibre sulphate pulp is used principally in coated and uncoated fine papers in which it enhances desirable qualities such as opacity and bulk. This grade of pulp is also used in tissue, sanitary products and other grades of cultural papers, bleached board, business forms and specialty papers.

The types of hardwood pulp currently in use in major markets can be divided into the following categories:

1. Birch - primarily made in Scandinavia.
2. Eucalyptus - mainly produced in Portugal, Spain, Morocco and Brazil.
3. Central European hardwood - hardwoods made in continental Europe with beech the predominant species.

4. Southern U.S. hardwood - hardwoods from the U.S. south, produced predominantly from oak and gums.
5. Northern American hardwood - hardwoods produced from the northeast region of North America, predominantly maple, birch, beech and aspen.
6. Mixed Tropical hardwood - made from tropical hardwood species in Asia (e.g., Philippines), Latin America and West Africa.

Traditionally, bleached birch pulp from Scandinavia has been the preferred hardwood pulp, particularly when a degree of strength is required in combination with good formation and surface properties. However, non-traditional hardwood pulps, such as eucalyptus and mixed tropical hardwoods, have increased in importance and are now well-recognized for their unique properties and have become well-established in world markets.

In terms of technical suitability, bleached aspen sulphate pulp would be equivalent to birch pulp in certain applications and at least as acceptable as European beech in all paper and paperboard products.

In 1981, Canadian shipments of bleached kraft hardwood market pulp amounted to 593,000 tonnes or approximately 10% of the total Canadian shipments of paper-grade chemical market pulp. By comparison, bleached kraft softwood market pulp accounted for 81% of the total Canadian market pulp shipments in the same year. There are, at present, seven mills producing bleached kraft hardwood market pulp in Canada, all located in eastern Canada. These mills shipped approximately 200,000 tonnes to domestic markets in 1981. The remaining production, 393,000 tonnes, represented 66% of the total shipments and was exported primarily to the United States (U.S.).

Western Europe traditionally has been a large market for Canadian hardwood market pulp and, in recent years, about 40% of the total exports of this grade was shipped there. For a mill in Alberta or the B.C. interior, western Europe does not appear to be a promising market because transportation costs would be considerably higher than those from eastern Canadian production units.

More promising markets would be in the U.S., particularly in the mid-west and western regions. Hardwood sulphate pulps are produced primarily in the U.S. northeast and southern regions, with only a relatively small amount in the mid-west. As in Canada, the western part of the U.S. does not have a local supply of market bleached hardwood pulp, and, therefore, markets for this pulp, based on aspen, could probably be developed in the aforementioned regions for most of the production from a new mill in Alberta or B.C. It has been established that aspen-based pulp can be as good or better than the standard North American mixed hardwood pulp for most applications. The U.S. imports substantial quantities of bleached sulphate hardwood pulp from Canada and, in recent years, also from Brazil. For example, in 1981, 55% of the total imports came from Canada and about 42% from Brazil.

It is conceivable that a supplier, located in Alberta or the B.C. interior, could also allocate a part of its production for sale in Japan or other Asian markets (e.g., South Korea). In 1980, Japan imported 410,000 tonnes of bleached kraft hardwood pulp of which 48% came from Brazil, 30% from the U.S., 15% from Canada and the remaining 7% mainly from Scandinavia. It is noteworthy that all major suppliers, other than Canada and the U.S., are located further from this market than would be a producer in B.C. or Alberta. Distance from the market is not, however, the only variable in freight structures. Other factors such as product density, availability and frequency of service from mill to market also affect transportation costs.

In summary, the most promising markets for an aspen-based mill, located in either Alberta or B.C., appear to be the mid-western and western regions of the U.S. and, to a lesser degree, some Asian countries. The potential for developing pulp sales to those markets appears to be very strong since no significant market-related constraints appear to exist. If constraints do exist for aspen-based bleached kraft pulp, they would relate to production cost and could only be identified through a detailed technical/economic study.

Market Mechanical Pulp

In 1980, world production of mechanical pulps totalled 26.7 million tonnes, but only 1.3 million tonnes (5%) were classified as market pulp sold in international markets.

Scandinavia is the largest producer of market mechanical pulps with an output of 830,000 tonnes or approximately 64% of 1980 world production.

During the 1970's, production and consumption of market mechanical pulp varied widely in response to business cycles, but an important underlying factor was the trend towards higher utilization of bleached mechanical pulp grades. With the exception of a few small plants, each mill in Scandinavia now has facilities to produce the bleached grades.

Canada is the second largest producer of market mechanical pulp with an installed capacity of approximately 520,000 tonnes in 1982, almost all of which is concentrated in three mills. A mill, which started in 1981 in B.C., is presently installing bleaching facilities and will produce bleached CTMP starting in 1983. New Zealand is the only other producer of market mechanical pulp of any significance, although the bulk of the production is captive, mainly for Japan. New Zealand is also developing bleaching capability.

Utilization of bleached mechanical pulp grades in printing and writing papers will likely increase in western Europe, mainly because of the faster growth of coated mechanical papers relative to other grades of printing and writing papers. Potentially, high yield bleached mechanical pulp could also displace some bleached hardwood chemical pulps in printing and writing papers, but the paper quality requirements, such as high brightness and low brightness reversion, might constrain this considerably.

Although the total demand for paper and paperboard products in western Europe declined in 1981, demand for tissue and sanitary products is expected to grow at an average annual rate of 3% to 1986. Demand for high brightness mechanical pulp for higher quality tissue and sanitary products is expected to increase at a rate of 3% or possibly slightly higher.

In the softwood-deficient regions of Asia, such as Japan, South Korea, Taiwan and India, the high cost of imported softwood pulpwood and the high cost of energy are major reasons why these countries search for offshore mechanical pulp on a stable long-term basis. It is estimated that, at the peak of the pulp cycle, i.e., in 1986 or 1987, demand for market mechanical pulp in Japan will reach approximately 700,000 tonnes per annum, an increase of 300,000 tonnes over the 1980 level. In other countries such as the Peoples'

Republic of China, foreign exchange shortages will encourage the import of pulp rather than the alternative of higher value imported paper.

Because of its location, a mill in Alberta or B.C. would have to seek markets mainly in the U.S., particularly for tissue and household products. Although the trend in integration of pulp and paper operations in the U.S. is expected to continue throughout the 1980's, the tissue and household segment will remain largely non-integrated. This is a market sector where the transportation, marketing and distribution costs of finished products are more important factors than the costs of producing pulp on the same site. Consequently, this sector offers a better opportunity for bleached market mechanical pulp than the sectors producing bulk commodities such as some grades of printing, writing papers and bleached boards which are becoming more and more integrated.

Eleven new machines for production of printing and writing papers, with a total capacity of 1.08 million tonnes, were installed in the U.S. in the period 1976-1980, all fully integrated with pulp production. Over the same period, 36 printing and writing paper machines, with a total capacity of 554,000 tonnes, of which 220,000 tonnes was in non-integrated mills, were permanetly shut down. Continuation of this trend will have a negative effect on demand for all grades of bleached market pulps and could hinder any attempt to place bleached market mechanical pulp in U.S. markets from Alberta or B.C.

There appears to be a market for CTMP, bleached for tissue and related grades, in the U.S. This indicates that the technical-economic feasibility of producing such pulp should be pursued in B.C. and Alberta. The size of this market can only be determined in an end-use study which is beyond the scope of this project. Since, according to the technical report contained in Volume 2, aspen is a preferred species for bleached mechanical pulp and the market potential appears quite promising, further investigation appears to be fully justified.

Newsprint

In the short and medium term, i.e., 2 to 5 years, market prospects for a newsprint mill, located in Alberta or B.C., are not promising due to the impending serious over-capacity of newsprint in the North American industry. The imbalance will tend to intensify competition for markets in North America as well as offshore. For the next two years or so, the Canadian newsprint industry is expected to operate at barely 80% of capacity, while the Canadian share of U.S. newsprint markets is projected to decrease by 4 to 6% from the 1980 level. The Canadian operating ratio for 1985 has been estimated at about 86% - well below the historic average. Although the market is expected to improve by 1985-86, several more years will pass before the imbalance is eliminated.

Market prospects, from 1987-88 onward, for a newsprint mill in the B.C. - Alberta region could be promising. Long-term forecasts indicate that newsprint consumption will increase at a modest but fairly steady rate. Over the period 1985-95, world consumption of newsprint is forecast to increase by 8 million tonnes on the basis of a 90% operating level. World capacity for newsprint would need to be approximately 41 million tonnes by 1995 in order to supply the demand. Consequently, over this period, 6 million tonnes of new capacity will be required, equivalent to the annual production of approximately 25 modern newsprint machines each of 160,000 tonnes capacity. The actual capacity requirements might be even higher since the estimate does not include replacement of obsolete machines.

Potential markets for a newsprint mill located in Alberta or the B.C. interior are likely to be found in the U.S., Canada and, to a lesser degree, in offshore markets. The mid-west and western regions of the U.S., especially the mountain regions of the west (e.g., Colorado), should be considered promising markets as they are presently supplied by mills in the U.S. Pacific northwest, the south, B.C., and eastern Canada, all of which are a considerable distance from these markets.

The Canadian market for newsprint production from Alberta or B.C. will be relatively small as it is anticipated that sales would be confined to the Prairie provinces.

As an independent source of supply, a mill located in Alberta would find it difficult to compete with the coastal mills in offshore markets. In fact, the risk involved in marketing newsprint produced in the regions under review, even in North American markets, will be considerable. However, there are several methods of reducing or eliminating potential difficulties arising from market constraints which could be applied in this case. A potential producer could seek a joint venture partner, in terms of equity participation, with either a domestic or foreign publisher who would be prepared to buy a substantial quantity of newsprint for his own end-use. Alternatively, a joint venture could be arranged with an existing large newsprint producer who has an established marketing organization through which the majority of tonnage would be sold. This applies particularly to overseas markets.

In summary, on the basis of a preliminary analysis, short-term market prospects for an additional newsprint mill, located in Alberta or B.C., do not appear to be favourable because of the existing and impending imbalance in supply/demand. Long-term market prospects, i.e., from the late 1980's on, are more promising, especially if a joint venture is undertaken. An in-depth study of these findings, particularly those related to North American regional markets should, however, be undertaken prior to any development decisions being taken.

Printing and Writing Paper

The printing and writing paper category encompasses a wide variety of papers. Markets for these grades are characterized by a limited number of large buyers and a high level of competition in terms of price and quality. For merchandising reasons, the production of printing and writing papers usually requires a wide range of grades in terms of basic weight, finishes, colours and sizes. There are, however, a few homogeneous grades which are produced in large volumes and sold as commodities in the open market. These include, the BMDX (bond, mimeograph, duplicating and copy) grades which are so similar in sheet properties and basis weights that many mills make the same paper for more than one end-use. Mills commonly swing between grades depending on the demand for a particular product. These grades, which are also used for offset printing, are generally made from 100% bleached chemical pulp (50/50 softwood/hardwood), and hence are classified as uncoated wood-free papers. Other examples of large-volume commodities found in the mechanical printing and writing paper category include grades such as uncoated groundwood publication paper (e.g., telephone directory paper, catalogue paper, etc.) and lightweight coated (LWC) groundwood paper used in magazine publishing.

In order to produce these grades, a market would have to be developed for a paper machine producing between 300 and 500 tonnes per day. For a mill located in Alberta or B.C., such a market could only be found in the U.S. because Canadian markets are limited and already well served by current suppliers. A supplier located away from the B.C. coast would also be at a disadvantage vis-a-vis coastal producers servicing offshore markets.

The U.S. consumption of coated mechanical grades is projected to increase, during the 1980's, at an average annual rate of 3.2%; uncoated wood-free consumption is estimated to grow at 2.8% annually, and uncoated mechanical grades at 2.6% per annum. Consumption of all remaining grades is expected to grow at rates lower than any of the foregoing.

Most of the U.S. demand for the mechanical coated grades is filled by LWC groundwood paper. The total U.S. consumption of LWC groundwood paper for all end-uses was estimated to amount to approximately 2.2 million tonnes in 1980. The U.S. is now experiencing a period of oversupply in coated mechanical grades which is expected to prevail at least until the mid-1980's.

However, a preliminary analysis of the supply/demand balance for lightweight coated mechanical papers in the western U.S. region shows a different picture. The region is supply deficient and will continue to be serviced from other U.S. regions. There is, therefore, a potential for western Canada, providing suppliers can be competitive. Demand for LWC mechanical paper in the western U.S. is expected to increase from approximately 180,000 tonnes in 1980 to 450,000 tonnes by 1990. Reasons for the demand include an expected increase in population in the western U.S. from the current 20% to 22% of the U.S. total by 1990. Furthermore, escalating postal and freight rates are expected to lead to the production of commercial and publication printing paper on a more regionalized basis. The trend to small, regional, special interest magazines will give the printers in the western U.S., particularly in California, an opportunity to increase local printing activities. Only one production unit for LWC mechanical papers currently exists in the western U.S. and at least two modern machines, each with a capacity of 150,000 tonnes annually, will probably be required by 1990. This new capacity could be located either in Alberta, B.C. or the northwest U.S., depending on relative economic considerations.

Logically, a papermill located in Alberta, or B.C., should be fully integrated with a pulp mill to take advantage of the raw material base. It should be pointed out that, to produce any grade of printing and writing paper, at least 30% of the furnish will have to be bleached kraft pulp which should, for economic reasons, be produced in-house rather than purchased.

In summary, the opportunity to develop a market for the output of at least two new machines producing LWC mechanical papers in western Canada appears to be excellent in the latter half of the 1980's. Although some pulp and paper companies located within the region are known to be contemplating expansions, no commitments have been made as yet. Whether or not a mill located in Alberta or the B.C. interior would be competitive in the identified markets could only be determined through a detailed feasibility study.

Medium-Density Fibreboard

Medium-Density Fibreboard (MDF) is not manufactured in Canada, although Canadian companies have developed overseas markets for MDF imported from the U.S. for re-shipment to Japan, Southeast Asia and western Europe. In addition, increasing volumes of MDF produced in the U.S. are being sold in both western and eastern Canada. MDF possesses characteristics quite distinct from either particleboard or hardboard, and is replacing both of these in important market sectors. Reliable estimates indicate that a total market, domestic and overseas, of up to 250,000 cum annually is currently available to a western-based MDF plant. The Canadian market constitutes approximately 20% (50,000 cum) of this annual total. Since the capacity of a world scale plant amounts to approximately 100,000 cum per annum, at least 50% of the total output could be marketed domestically and the remainder overseas. Although the Canadian market could not, as yet, absorb the total output of a plant, it should be noted that consumption of MDF in Canada, and elsewhere, has been increasing at an average annual rate of approximately 10%.

An additional, and very important consideration, is that the fibre furnish for an MDF manufacturing process could be in almost any form - roundwood, shavings, sawdust, forest biomass or residue from any wood conversion system. In other words, MDF possesses the advantages of a manufacturing system which is compatible with poplar's natural characteristics and one which can utilize virtually the entire forest yield.

Although MDF can be produced from almost any type of wood residue and therefore could conceivably be manufactured within potential market areas such as Japan, the fact that the manufacturing process requires a relatively high energy input severely restricts the attractiveness of producing MDF in energy deficient countries such as Japan.

For the above reasons, MDF manufacturing in either Alberta or B.C. should receive a high priority for any development. It should be noted, however, that production economics require the raw material supply to be the by-products of a wood processing unit rather than roundwood cut especially for the MDF mill.

Thin Particleboard (Thinboard)

Thin particleboard differs from the standard industrial particleboard in both manufacturing method and end-use applications. Virtually all standard industrial particleboard is produced in multiple-opening press systems, whereas thin particleboard is produced in a single-opening, more-or-less continuous press system. Furthermore, the multi-opening process operates most economically on finished board thicknesses of 1/2" (1.3 cm) and up, whereas the single-opening system operates most efficiently when producing boards 1/8" (0.32 cm) to 3/8" (0.95 cm), hence, the term "thin" particleboard.

While industrial particleboard is used almost exclusively for furniture manufacture, thin particleboard, which may also be used in furniture manufacture, has, in addition, gained acceptance as wall covering (panelling) material. This latter use constitutes the major market for thin particleboard which is usually employed as a substrate to which veneer, plastic film, printed paper or paint is applied. Thin prefinished particleboard is rapidly replacing thin hardwood plywood which has been supplied mainly from producers in Southeast Asia.

There are four thin particleboard plants operating in Canada and six in the U.S. at this time. Of the Canadian plants, three are in eastern Canada and these collectively export approximately 35,000 cum to the U.S. annually. The one plant in B.C. has developed modest sales to the U.S., with the remainder flowing to the western Canadian market.

Although North America would constitute the major market for additional thin particleboard production, strong interest in this relatively unknown product has been expressed by importers in Japan, Taiwan, Korea and Hong Kong. As with MDF, thin particleboard offers the opportunity to produce economically the panel sizes required in Japan, approximately 1 m x 2 m, in addition to the standard North American panel size, 1.2 m x 2.4 m.

Although face-finished thin particleboard has been exported recently from Canada to western Europe, the presence of a massive particleboard manufacturing industry in that region ensures continuation of existing import duties. This factor, combined with the probability of developing a market which could be easily acquired by local manufacturers, makes the region unattractive as a potential market for thin particleboard from western Canada.

For a plant located in Alberta, the cost of transportation to a west coast port would not be significantly higher than that for a plant located in the northern interior of B.C. The critical economic factor in either case would be the cost of wood fibre delivered to the plant. Ideally, this furnish should consist of residue generated as a by-product of a wood processing unit, such as a sawmill, located on the same site.

Thin particleboard appears to be a product which offers definite potential for development in either Alberta or B.C. The scale of the development would depend on several factors. Foremost amongst these would be the volumes of overseas and U.S. sales commitments which could be obtained prior to the investment decision being taken. Site selection to minimize transportation costs into and out of the plant, and to ensure the availability of adequate labour and service facilities, would be an important factor for consideration.

Lumber

Production and marketing of poplar lumber could be considered an attractive investment opportunity provided several conditions are fulfilled.

The first, and probably most important, is that an outlet for efficient and economical utilization of the sawmill residues be provided. Commercial experience has shown that these residues would constitute at least 55% of the total log input and the long-term economic viability of a poplar-based sawmill would depend primarily on an economic conversion system. The most logical use would be as raw material supply to a panel plant located adjacent to the sawmill.

A second, almost equally important condition, is that the sawmill be designed more for quality recovery than for quantity throughput. Except for a number of relatively small mills located in eastern Canada, most poplar lumber producers have attempted to compete for a share of the highly competitive, volatile construction/building market. This market is dominated by the softwood species - in particular the species referred to as SPF (spruce, pine, fir). Experience has proven that lumber can be produced from softwoods at much lower cost than from poplar. Consequently, poplar lumber producers are the first casualties in any economic downturn even though the producers, particularly in western Canada, are closely allied to the major consumers of poplar lumber - the pallet manufacturing industry.

Processes and techniques for the recovery of the highest possible proportion of clear lumber from small, crooked, low-quality logs have been developed over the past several years and should be carefully evaluated to determine their application to the poplar resource in Alberta and B.C. Additionally, methods for producing furniture components from low quality logs have also been developed to the pilot plant stage, and these should also be evaluated in relation to poplar. Details are provided in Volume 3.

North America represents the most promising market area for high quality poplar lumber and for poplar furniture components, with the California and mid-western states constituting the major potential market areas in the U.S. Clear poplar lumber could also be readily marketed in Japan, Southeast Asia and, possibly, western Europe. Sales returns from upper grades of poplar lumber probably would be high enough, relative to standard grades, to absorb the additional recovery costs.

The construction and/or operation of a poplar-based sawmill, designed for construction grades of lumber only, would not be an attractive investment. However, as part of a multi-product complex, designed and operated for grade selection rather than volume, and with a modest degree of secondary manufacturing capability, the market potential for a poplar-based sawmill appears promising enough to warrant a detailed site -specific feasibility study.

Wood Chips

Although both the price and consumption of wood chips have increased at dramatic rates over the past several years, poplar wood chips are only marginally attractive as an investment opportunity. Pulp production represents the only current economic end-use for wood chips and the established markets for hardwood pulp chips are in eastern Canada (modest volumes only), the mid-west and eastern U.S., and Japan.

Two major factors influence the potential for poplar chip sales. The first is cost. Virtually all wood chips are produced as by-products of a primary wood processing system (usually a sawmill), consequently, production costs are relatively low. Since no significant volumes of poplar are being processed in western Canada, a whole-log chipping facility would be required and the cost of producing poplar chips, as a single product, would be uneconomically high.

Transportation costs to the major market areas constitute the second major constraint. The ratio of the weight of actual fibre content to the space occupied is significantly lower for poplar (a low density species) than for most softwood species, thus, poplar chips attract high unit transportation costs. It is nevertheless true, however, that poplar chips have been proven technically acceptable for hardwood pulp furnish and that Japan and other Southeast Asian countries are predicting an increasing dependence on imported fibre. Therefore, if poplar chips were produced as a by-product, and if methods for reducing the transportation costs were developed (such as compacting the chips at source), unquestionably, poplar chips could be marketed profitably and should be made a part of the evaluation of any poplar processing complex.

Standard Particleboard

Particleboard has enjoyed a strong growth trend in Canada and in the U.S. in both the thinboard and standard panel categories. The consumption trend for standard panels in Canada, covering all market sectors including miscellaneous manufacturing, millwork, furniture, cabinets and the retail trade, is increasing at a rate of about 7% annually.

An important factor in consumption of particleboard is the effect of imported MDF which is steadily encroaching on the standard particleboard market. The characteristics and properties of this panel make it superior to particleboard for almost every use and enable it to be sold at a price level 20-25% higher than particleboard. Transportation costs are therefore, not as critical to MDF distribution as they are to standard particleboard marketing.

Other factors limiting the opportunity to market poplar-based standard particleboard produced in either B.C. or Alberta are:

(a) the lack of low cost poplar residue.

(b) transportation costs to the major eastern Canadian markets.

(c) the current over-capacity and planned expansion in eastern Canada.

For much the same reasons as in Canada, the opportunity for exporting standard poplar particleboard to the U.S. is restricted. Approximately 80,000 cum of standard particleboard will be exported to the U.S. in 1982. This is, however, virtually all derived from eastern production and is based on low-cost sawmill and plywood mill residue. One eastern particleboard mill does, in fact, convert poplar roundwood into particleboard but this plant enjoys a geographical market advantage in Canada and a captive market with its U.S. parent.

When the transportation advantages enjoyed by eastern Canadian mills are added to the capacity and supply advantages of U.S. particleboard mills, 32 of which are located in the southern and eastern states, the opportunity for western Canadian particleboard exports to the massive mid-west market is diminished considerably. Additionally, the opportunity for sales to the U.S. western states is minimal because of the large existing capacity in that region.

Energy

Energy, in the context of this study, refers only to electrical power generated as a by-product of the steam produced for use in a manufacturing complex. This is described as co-generated power.

Until the recent energy crisis, sale of co-generated power to a public utility occurred only under unusual circumstances and was not regarded as a possible source of revenue by forest products companies. In fact, until very recently, B.C. Hydro, for technical reasons, tended to discourage investment in this type of venture. However, escalating costs of producing thermal power from coal and natural gas, and current high capital costs, combined with environmental problems of installing additional hydro capacity, have drastically altered public utilities' attitudes. In both Alberta and B.C., beneficial private power supply contracts could now be negotiated fairly readily. Demand for power and the urgent need to conserve fossil fuel in the U.S. have resulted in federal and state legislation which imposes severe penalties on utilities which do not purchase a portion of their total power supply from forest-based private co-generators. Additionally, the legislation requires that the rate negotiated between the co-generator and the utility is based on current construction costs and not on depreciated plant value. This latter value, on which traditional utility rate structures have been based, is considerably lower than current building costs. Therefore, new private co-generators would be in a position to sell power at a rate greater than the rate charged to them by the utility company.

The concept of negotiating on this "avoided costs" basis has not yet been adopted in Canada, but the utilities, particularly in Alberta, have indicated a strong interest in co-operating in the development of forest-based co-generated power.

Therefore, potential industrial development based on the poplar resource of Alberta and B.C. should include serious consideration of the expansion of the development to include generation of excess power for sale to the relevant public utility.

Waferboard

Technically, waferboard is an excellent panel from the aspect of consuming poplar roundwood and is also a panel which has achieved remarkable penetration of the structural panel market. However, recent expansions in capacity in Canada and the U.S. tend to lessen the attractiveness of waferboard investment in western Canada.

Waferboard will continue to replace coniferous plywood in the markets related to housing, non-residential construction and do-it-yourself projects. However, the future trend in new housing starts in Canada is strongly downward and existing waferboard capacity will probably be adequate for at least the next five years.

Recently installed capacity in the U.S. and announcements of planned expansion are of particular significance to Canada. The committed new capacity will exceed that of Canada by the end of 1983, and will be at least double the existing Canadian capacity (1.3 million cum) within the next two years. Since the U.S. has normally consumed 50% of Canada's annual waferboard output, an obvious conclusion is that the expansion in the U.S. will force a reduction in imports from Canada. Canada will continue to share in the overall U.S. market, but its position and annual volume will undoubtedly decline. The extensive U.S. softwood plywood industry is also a major factor. There is, however, a regional aspect which should be considered for a western mill. This is the market area of southwest California to which western Canadian waferboard may be shipped at competitive transportation costs. The two existing mills in Alberta appear to be well placed for shipment to this market which probably will not require additional Canadian supplies for some time. Reportedly, it will also be served in the near future by new western U.S. capacity.

European markets for waferboard are considered to be questionable because of the massive European particleboard industry, the intensive marketing programs by the Canadian and U.S. coniferous plywood industries, the imports of Southeast Asian plywood, and special tariff arrangements. While considerable effort has been exerted by the Canadian Waferboard Association, only minimal shipments have been achieved and the low level of acceptance is not expected to improve significantly in the forseeable future.

In Southeast Asia, waferboard must compete in both price and technical performance with a large, but changing plywood industry. The housing styles do not permit large volumes of sheathing materials to be used and, in the concrete form panel sector, plywood will be the dominant factor for some time to come.

Japan, however, has a tradition of wood-based housing and an immense housing demand which will require structural panels. Interest has been aroused by the major promotional campaigns by both Canada (mainly COFI, aided by special federal and provincial funds) and the U.S. west coast industry to introduce timber frame housing styles which incorporate large volumes of plywood. Some success is evident but a major breakthrough has not occurred. Waferboard, should it pass the intensive technical investigation which the Japanese would impose, might also penetrate the market. Waferboard could offer panels in the traditional 1 m x 2 m sizes widely employed by Japan, although panels produced in the currently installed Canadian presses are not suited to this module.

For these reasons, it is apparent that the currently installed waferboard capacity in Canada and the U.S. appears to be more than adequate to satisfy probable demand for the forseeable future.

Veneer and Plywood

The Canadian consumption of poplar plywood for both structural and non-structural uses appears to have stabilized at 100,000 cum annually.

Export markets are small and are in the north-central and northeastern U.S., close to the concentration of mills in Ontario and Quebec. Some of the special uses for toys, games, cable reels, etc., occur in this market which is also supplied by the relatively small poplar plywood production in the U.S.

Technical and economic problems, mainly related to the low recovery of finished products from log input, encountered in producing veneer and/or plywood from poplar are of major importance and have caused the almost complete abandonment of this type of production in western Canada, except for an intermittent production of veneer.

Poplar veneer may be sold as a component of industrial and structural panels, often combined with coniferous veneers, but the market is not consistent enough to offset the production losses which are inherent in poplar veneer manufacture. Industry sources, with extensive experience in poplar production, are strongly negative regarding either poplar veneer or plywood production in the west.

While future raw material supply for plywood is of concern in Asia, there appears to be no chance in the foreseeable future of selling anything other than the highest grade and sizes of poplar veneer, which would be compatible with the type of veneer now generally utilized in that region. Other than a relatively small market for specialized poplar veneers for uses such as chop-stick production, the prospect for market penetration in Asia appears to be very poor.

In summary, for technical and economic reasons, poplar veneer and/or plywood should not receive a high priority for future development work.

Hardboard

The Canadian hardboard industry has undergone significant changes in product mix over the last 10 years and now concentrates on siding, which amounts to 50% of total output, with the balance being a mixture of doorskins and plain and decorative (prefinished) panels. Prefinished panels probably account for 25% of total production. The Canfor Ltd. mill at New Westminster, B.C. is a major element in this sub-sector.

Low cost imports of plain hardboard, mainly from the U.S.S.R. and the rapidly developing Canadian thin particleboard industry have forced the hardboard producers to rationalize their product lines to items where cost effectiveness is maximized as described above. Some prefinished panels of patterns and styles which have limited market acceptance will continue to be imported from the U.S. since the cost of making short runs, each of which requires an expensive, special press "caul", is excessively high.

The U.S. is the leading, although small, export market for hardboard, primarily doorskin panels from eastern Canada. This is a limited opportunity because of the very large U.S.

capacity. Total exports cover a wide range of small shipments to various countries but account for only 15% of production. Europe, while consuming small intermittent volumes from Canada, suffers from a chronic over capacity and is a poor long-term prospect for Canadian exports.

Pulpwood

The extraction and sale of poplar pulpwood (roundwood logs) does not appear to be economically feasible. Demand for this product is virtually non-existent in western Canada and in neighbouring U.S. regions. Poplar in roundwood form has been accepted to a limited degree in eastern Canada and the mid-western U.S. but more than adequate supplies of poplar exist in each of those regions. In other words, transportation costs to established poplar pulpwood markets in North America would place a western Canadian based operation in a continuous non-competitive position. A substantial market could probably be developed in Japan but, again, transportation costs from either Alberta or B.C. would place any Canadian shipper at a substantial disadvantage relative to the U.S.S.R. which also supplies poplar to Japan.

For these reasons, and also because sales of pulpwood would reflect the minimum value added contribution to each province's forest products activity, the recommendation is made that this product receive a very low priority for further consideration.

Chemicals

A vast array of chemical products can be, and have been, produced from poplar. In fact, virtually every organic chemical presently known may be produced from the primary chemicals extracted from cellulose, hemicellulose or lignin which are constituents of all wood material.

The array of potential chemical products is therefore extremely broad and in order to ensure sensible analysis of the potential markets for chemicals within the scope of this study, current production, distribution and consumption of a selected list of primary organic chemicals has been examined as follows:

Acetic Acid
Acetone
Butadiene
Butanol
Butylene Glycol
Charcoal and Activated Carbon
Ethanol
Furfural
Hydroxymethyl Furfural
Glucose
Glycerol
Lactic Acid
Methanol
Low Molecular Weight Phenols
Methylated Phenols
Salicin
Sorbitol
Vanillin
Xantham Gums
Xylitol
Xylose

World trade in organic chemicals has grown at an average annual rate of 19% from 1976 to 1980. Of major significance to the potential conversion of poplar species to chemicals is the fact that the market is completely dominated by the petro-chemical industry. Virtually all organic chemicals are traded on a commodity basis and prices, therefore, are very sensitive to changes in supply and demand and to changes in world oil prices.

In addition to the above, there is an over-supply of the chemical products which are most readily obtained from poplar wood material. For example, methanol, one of the basic chemicals, was in an over-supply position of some 6.4% on a world-wide basis in 1979 and this is projected to increase to 17.5% by 1983. In Canada, the excess capacity for the same period is expected to amount to 127% and 602% of demand respectively, as two world-scale plants, one in B.C. and one in Alberta, come on stream. Both are based on natural gas feedstock.

These two developments virtually eliminate the opportunity for conversion of wood material into methanol, based on a most cursory estimate of relative costs. For this reason, it is concluded that methanol production from poplar species is not viable and should not be pursued in the immediate future.

Installed ethanol capacity, a major commodity which can also be produced from wood fibre, at present exceeds demand by varying amounts in all major consuming regions. For example, in the U.S., capacity exceeds demand by 3% and in Japan, the excess amounts to approximately 77%.

Transportation and distribution methods for primary organic chemicals play a major factor in marketability. Delivery to major consuming countries requires tankership loads of up to 100,000-150,000 tonnes per vessel. Production facilities must therefore be capable of producing chemicals in large volumes which, for wood-based processes, demands an extremely large forest resource. This fact, combined with a number of other considerations such as the world excess capacity position, the probable uneconomic results of producing chemicals from wood, the still largely experimental nature of commercial production of wood-based chemicals, and the domination of the markets by petrochemical producers, restricts the potential of marketing poplar-based chemicals from Alberta and B.C.

Future supply and demand balances and the probable future viability of marketing wood-based chemicals are very difficult to predict. These products would be forced to compete with petroleum, natural gas and coal which dominate the market and which, under present technology, can be produced at much lower cost than fibre-based chemicals. A key element, therefore, is the future costs of non-renewable feed-stock and predicting these is beyond the scope of this study.

However, there does appear to be some opportunities for the marketing and sale of chemical products that are produced in relatively small volumes as by-products of other poplar resource processing facilities, such as sulphite pulp mills. These include methanol, (formerly recovered by Canadian International Paper Co. at Gatineau, P.Q.) and vanillin (produced by the Ontario Paper Company in Thorold, Ont.). Other minor products such as salicin, low molecular weight phenols and xylitol may offer opportunities when recovered as by-products, particularly if continued research can solve the technical problems presently inhibiting widespread acceptance in the markets. Lignin, for conversion to adhesives as a partial replacement of phenol-formaldehyde and as a binder in other processes, is extracted at two eastern Canadian mills. The first named use is still experimental. The second use has existed for years at a relatively low annual production rate.

Continued research to improve yields, reduce capital and operating costs and to improve fast growth species will be required in order to permit penetration of the organic chemical market at some time in the future. It is also possible that, should international oil prices increase substantially, existing or developing technologies for poplar-based chemical production may become economically viable. To this end, a continuous monitoring of oil prices, chemical prices and production economics may be desirable.

Poplar species are not widely used for charcoal production because of their low density ranges. For fuel charcoals, the heavier hardwoods are more suitable. The volume of charcoal, both coal-based and wood-based, consumed in Canada for all types of miscellaneous heating, barbecue briquettes, etc. is probably less than 50,000 tonnes annually. Imports from the U.S., made from high-density hardwoods and coal, make up a large percentage of the market.

Activated carbon is a more technically demanding and specialized form of carbonized wood for which poplar may be an acceptable substitute for some of the raw materials, including pulp mill waste, which are presently used.

The Canadian market for all types of activated carbon is about 6,000 tonnes annually with a value of about $10,000,000, mainly supplied by imports.

Studies of charcoal and activated carbon markets are not considered to be of high priority but might be considered as an adjunct to other poplar processing plants.

Animal Feed

Although a number of products and processes have been developed experimentally for the production of animal feeds from wood fibre, only the three products assessed in this study have achieved actual, although limited, utilization. These products are generally referred to as "Pro-Cell", "Mukka" and "SCP" (Single-cell protein).

Mukka and Pro-Cell have been demonstrated to be acceptable substitutes for brome alfalfa or equivalent hay (fodder) products. As such, both products can be consumed, either directly or in admixtures with vitamins or other supplements, as part of the diet, for cattle or other ruminants. Both products have potential for use in regions where hay supplies are limited by climactic or other factors. The selling price is established by the price of brome alfalfa hay in any given region.

Extensive research conducted by federal and provincial agencies, universities and other research organizations has clearly demonstrated that both Pro-Cell and Mukka are acceptable feeds but they must be enriched with vitamins and other supplements to approximate the nutrient value of established animal feeds. The conclusion was also reached that the costs of production, supplements and transportation combine to make these products economically unattractive. Most government agencies have recently reduced the level of research and development directed towards the technology and processing of wood-based feeds. Therefore, the potential for utilizing significant quantities of Alberta or B.C. poplar for the production of animal feed appears to be very low.

SCP, based on a bacterial conversion process, has only recently come into production on a pilot plant scale in Canada. The material is extracted as a by-product of pulp mill operations. Although the SCP process does not appear, under current economics, to be financially attractive as a single product operation, other factors such as reduction of waste disposal costs at a pulp mill, apparently assist in developing a favourable economic structure. Although current trials are based on coniferous sulphite mill wastes, the development could have a potential application to poplar material, if this were available as a pulp mill effluent.

Export marketing of SCP may be possible if acceptance by agricultural regulatory agencies in the U.S. is gained. However, overseas sales are considered to be dependent on acceptance of SCP as a food suitable for human consumption and the existing stringent quality standards definitely preclude this possibility.

Specific economic analysis will be required for any of these three animal feed products in order to determine their practicality for utilization of the poplar resource in Alberta and B.C. At present, the opportunities appear to be very limited and, as with chemicals, any industrial development of the poplar resource based on cattle feed does not appear to warrant a high priority for development consideration.

CONCLUSIONS

The study has identified several products which appear to have potential for successful manufacturing and marketing based on the poplar resources of B.C. and Alberta. Those with the greatest potential are listed below in order of priority for further investigation.

Selected Pulp and Paper Products:

- bleached sulphate market pulp
- market mechanical pulp
- newsprint
- printing and writing paper

Medium-Density Fibreboard
Thin Particleboard
Lumber

Attention should be directed to these products as a first priority, especially since the combination generally fits the concept of production facilities capable of processing large volumes of poplar roundwood for several end-uses.

The remaining products covered in this report offer either only a poor or moderate opportunity and are not, therefore, repeated here. It should not be concluded however, that there is no chance of development of any of these. Some may fit into the flow pattern of a complex as a subsidiary product in the overall concept.

It should be reiterated that the final decision regarding any of these products can be made only on the results of detailed feasibility studies. Sufficient evidence exists, however, to suggest that further study would prove some or all of the products to be economically viable under certain conditions.

A major conclusion is that any industrial development based on western Canada's poplar should include the capability of utilizing the entire forest yield. A poplar processing complex should provide the means for extracting the highest value possible from the forest and have the capability to process efficiently all residue material.

This requires several economically integrated manufacturing units, not necessarily all on the same site, through which the flow of logs from the forest is directed to maximize physical and economic recovery by the greatest possible use of the by-products of each stage of manufacture. From the point of view of the number of major products which could be developed, and the substantial annual volume of timber processed, a pulp mill is the keystone of the integration. The large daily input would include certain percentages of logs of sawmill quality which could be directed to an appropriate sawmill. The by-products of this might be pulp chips, furnish for panel mills, raw material for energy or chemicals. A portion of the logs might be utilized directly in some of these latter conversion processes, instead of passing through the pulping operation. Even in such a case by-products would be generated which could be utilized for secondary utilization.

A process such as the above appears to be the only logical way to utilize the poplar resource in sufficient quantities to begin to approximate the annual allowable cut. Experience indicates that a number of relatively small, non-integrated mills, with the exception of waferboard, are generally not viable in themselves. However, even in waferboard manufacture there are limits on the quality of logs which can be utilized successfully.

Two major options are apparent for consideration by public sector agencies:

(1) allow traditional supply and demand forces to establish the rate of increase in poplar utilization. This may require considerable time because of the current preoccupation and commitment to softwoods.

(2) initiate action to encourage the private sector in more rapid utilization of poplar by conducting studies of specific products, areas and markets, supplemented with programs of financial assistance.

RECOMMENDATIONS

In order to initiate action and draw the attention of industry to the potential of the resource, the following recommendations are made.

Site-specific feasibility studies should be undertaken for a multi-product complex.

Combinations of basic product lines which appear most logical, based on the markets identified previously, are:

(1) Selected pulp and paper plus lumber products.

(2) Sawmill plus medium-density fibreboard.

(3) Sawmill plus thin particleboard.

As suggested above, a pulp mill would provide a sound foundation from which to develop the other production units, all of which could probably support marketing opportunities. Other products, e.g., waferboard, chemicals, etc., do not appear to have a sufficiently strong market opportunity to warrant major investigation at this time, although they could be considered for potential involvement in a complex at a later date.

Any study of the various product combinations should include an analysis of the capability of producing at least all the "in-house" steam and electrical energy needs, and of the economics of expanding the energy capability to allow the marketing of excess electrical power to the relevant public utilities.

Since pulp and paper products play a significant and, perhaps,, decisive role in the development of a complex, planning should be commenced soon to allow for the extensive lead time required to design and erect these major facilities.

Several development assistance programs are presently provided by both federal and provincial authorities. Previous studies* have concluded that one of the most effective methods by which governments could encourage private sector investment is to prepare a "pre-development" report which, in effect, provides answers to most of the questions and problems which would be faced by any potential private investor. The report would be site-specific and would include at least the following items:

(1) Detailed forest inventory data.

(2) Site-specific supply, services and transportation data.

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*"Analysis of Poplar-Based Panelboard Development Options for Alberta", Government of Alberta, March 1982.

(3) Details of all licenses, permits, fees and clearances required by all government and private agencies.

(4) Identification of potential markets and possible joint venture (buyers) arrangements.

(5) Guidelines for obtaining financing assistance from public and private sources.

It is CHI's opinion that strong measures should be taken by the governments concerned if the challenge of increased, profitable utilization of the poplar resource is to be met. Certain sites should be selected for which an information package, along the lines suggested, would be prepared for the consideration of potential private sector investors, both Canadian and foreign.

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31-211	Products Shipped by Canadian Manufacturers
32-004	Shipments of Animal and Poultry Feeds
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APPENDIX

ABBREVIATIONS AND DEFINITIONS

ABBREVIATIONS AND DEFINITIONS

APL	Alberta Power Limited
ACSR	"Aluminum Conductor Steel Reinforced" Power Cables
ANPA	American Newspaper Publishers Association
API	American Paper Institute
AFNOR	Association Francais Pour Normalisation
BPA	Bonneville Power Authority
B.C.	British Columbia
BCH	British Columbia Hydro and Power Authority
CD	Calender Days
CDX	Exterior Sheathing Plywood - U.S. Grade Terminology
CHMC	Canada Housing and Mortgage Corporation
CIP	Canadian International Paper Ltd.
CPPA	Canadian Pulp and Paper Association
CSP	Canadian Softwood Plywood
CSF	Canadian Standard Freeness
CSA	Canadian Standards Association
CHI	Carroll-Hatch (International) Ltd.
CMP	Chemi-mechanical Pulp
C.I.F./cif	Cost Including Insurance and Freight
CIC	Crown Investments Corporation of Saskatchewan
cum	cubic metres
DRI	Data Resources Inc.
DIN	Deutsche Industrie Normen (W. Germany)

DIY	Do It Yourself
ECP	Edmonton City Power
EEMA	Electrical Energy Marketing Agency; (Alberta)
ERCB	Energy Resources Conservation Board; (Alberta)
EEC	European Economic Community
EFTA	European Free Trade Area
FAO	Food and Agricultural Organization of the United Nations
FAO/IWP	Food and Agricultural Organization/Industry Working Party
FAS	Free Along Side
fbm	foot board measure
FMT	Finished Metric Ton
GATT	General Agreement on Tariff and Trade
g/cc	grams per cubic centimetre
GDP	Gross Domestic Product
GNP	Gross National Product
gsm	grams per square metre
IMF	International Monetary Fund
km	Kilometre
kVa	Kilo-Volt-Amps (apparent power)
kWh	Kilowatt Hours (Consumption)
LVL	Laminated Veneer Lumber
M.D. Charge	Maximum Demand Charge
MDF	Medium Density Fibreboard
mW	Megawatts (Power)
Mt	Million tonnes
n/a	not available

nes	not elsewhere specified
NORSCAN	The United States, Canada, Sweden, Norway, Finland
n.o.p.	not otherwise provided for
NTIS	National Technical Information Service (Washington, D.C.)
OECD	Organization for Economic Cooperation and Development
OEM	Original Equipment Manufacturer
OSB	Oriented Strand Board
PB	Particleboard
PUB	Public Utilities Board; (Alberta)
PUC	Public Utilities Commission; (B.C.)
PURPA	Public Utilities Regulatory Policy Act (U.S.)
Q	Quarter
RMP	Refiner Mechanical Pulp
SCP	Single Cell Protein
S/C	Supercalendered
SGW	Stone Groundwood Pulp
sm	Square Metre
SPF	Spruce/Pine/Fir
SRI	Stanford Research Institute
SWE	Solid Wood Equivalent
S2S	Surfaced two sides
t	metric tonne
TDN	Totally Digestible Nutrient
TMP	Thermomechanical Pulp
tpa	metric tons per annum
TUC	Transalta Utilities Corporation

U.N.	United Nations
U.S.	United States
USDA	United States Department of Agriculture
WB	Waferboard
WFPL	Western Forest Products Laboratory

MONETARY UNITS	US$	United States Dollar
	C$	Canadian Dollar
	S$	Singapore Dollar
	HK$	Hong Kong Dollar
	NT$	New Taiwan Dollar

Volume

2

Market Assessment for Poplar Products

VOLUME 2 OF 3

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ALBERTA
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INTRODUCTION

In this, Volume 2 of the report "Market Assessment for Poplar Products", consideration is given to the market sectors of: (a) pulp, paper and the related products, pulp logs and chips, and (b) chemical products and animal feed. In Volume 3, the market sectors of: (c) dimension lumber and solid wood specialty products such as interior finishing, and (d) composite wood products such as veneer, plywood, laminated veneer lumber, waferboard, oriented strand board, fibreboard, hardboard, coreboard and particleboard are examined.

The reasons for which the Governments of Canada, Alberta and British Columbia (B.C.) jointly established and funded the study are based on the fact that an immense volume of under-utilized poplar species exists in the west.

The poplars account for 54% (1.9 billion cum) of Canada's total hardwood timber resource and almost 10% of the nation's total merchantable timber. The two western provinces contain almost 870 million cum (47% of the Canadian total), but less than 1% of the annual allowable cut (16 million cum) is actually utilized.*

The terms of reference specified that the study be confined to markets and marketing of poplar-based products. However, in most cases, market constraints are imposed by economic and technical factors and, of necessity, these factors must be discussed. A review of such factors has been included in the appropriate sections of this report.

In addition to data assembly, interviews were conducted in the potential market areas of North America, western Europe, Japan, Korea, Taiwan, Hong Kong and Singapore. Interviewees included forest products manufacturers, agents, distributors, researchers, end-users, transportation companies and appropriate government agencies.

From the considerable body of data assembled, certain market sectors emerged with varying degrees of potential for successful penetration by Canadian poplar-based products. Some, however, proved to be beyond the realm of possibility. Although, in some cases, chances of success appear sufficiently high to indicate further analysis should be considered, these appear to be viable only where closely integrated production units can be developed. This is especially true of some of the products reported upon in Volume 3.

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*Although several species of poplar occur in Canada, the most common in western Canada and the species included in this study are: P. tremuloides (trembling aspen), P. balsamifera (black or balsam poplar), and P. trichocarpa (black cottonwood).

PULP AND PAPER PRODUCTS

This section of the report refers to a market analysis for pulp and paper products which could be produced from poplar species found in Alberta and B.C. The study is not site-specific, i.e., it does not, for example, take into account the volume and quality of species available in any specific location in Alberta or B.C.

This section of the report, accordingly, contains an analysis of domestic and international markets for pulp and paper products which have been selected as potentially suitable for production. Although the primary objective is to utilize the available hardwood resource, it is our view that all paper and paperboard products would require at least a small portion of their furnish to be made up from long fibre (softwood) pulp.

The selection of potential products was in part based on a technical report prepared specifically for this project. The information and statistical data presented in this section were obtained from a variety of sources such as government and private agencies, pulp and paper associations, published reports, field trip interviews and files.

Due to limited domestic markets, the Canadian pulp and paper industry is predominantly export oriented. In order to emphasize this point, a world overview for pulp and paper products has also been included in this report.

SELECTION OF PULP AND PAPER PRODUCTS

Selection Criteria

The technology of the pulp and paper industry is such that most grades of pulp and paper products currently utilized can be produced from a variety of the primary cellulosic raw materials such as wood, bamboo and bagasse, as well as from recycled fibres such as wastepaper and textile residues. Nevertheless, there are certain limitations which are imposed on the range of marketable products by the nature of the raw materials and the nature of the markets for pulp and paper products.

In order to identify potential pulp and paper products which would offer apparent technical viability for production based on the poplars found in Alberta and, generally, the interior of B.C., and which could be placed on open markets, the following criteria have been applied:

1. Products must be technically compatible with the poplars available.
2. Products must be internationally competitive (cannot rely solely on the domestic market).
3. Products must be of comparatively high value and sold in bulk quantities to minimize the negative effects of transportation costs.

4. The markets in which the products will be sold must be well established, vigorous in growth and open. Special arrangements with foreign partners to sell in captive markets have not been taken into account even though these arrangements could be a critical factor for a successful development. This aspect is well beyond the scope of this study.

Identification of Potential Products

Although the wood species in question, i.e., aspen, balsam poplar and black cottonwood lend themselves to conversion by most of the conventional pulping and bleaching processes, the inherent physical properties of these species must be taken into consideration in the selection of suitable pulp and paper products. Furthermore, factors such as age distribution, amount of rot and/or stain, etc., can have a significant impact on the technical suitability of any species for pulp and paper manufacture.

The various pulps and paper products which have been considered as potential products are discussed briefly in the ensuing paragraphs.

As will be shown later in this report, most wood pulp is produced in integrated pulp and paper operations where it is converted to final paper and paperboard products. Only about 20% of the world wood pulp production is actually produced as a commodity to be traded in open markets. Among the wood pulps, which satisfy the selection criteria in terms of technical suitability of the available fibre resource and the opportunity to be sold as a commodity in large volumes in open markets, is bleached hardwood sulphate pulp, commonly known as kraft. It should be noted that wood pulps are usually classified in terms of the method of their preparation. Although bleached hardwood sulphate pulp is of lower strength when compared with softwood of comparable grade, it is an important component in the furnish for many paper and paperboard products such as printing and writing papers, tissue and sanitary products, bleached board, etc.

With the exception of eastern Europe and the U.S.S.R., bleached sulphite hardwood pulp, as a commodity sold in open markets, has declined in importance and, in our view, this trend will continue in the future. Due to potential environmental problems associated with the sulphite process, coupled with the fact that sulphite hardwood pulp is of lower strength than its sulphate counterpart, the production of this grade in Alberta or B.C. is not recommended.

Almost all unbleached chemical pulp destined for sale in open markets is unbleached sulphate pulp produced from softwood species. This grade of pulp finds its end-use mainly in packaging paper and paperboard where strength is emphasized. The poplars would produce very poor quality unbleached chemical pulps with little potential for marketing.

Technically, semichemical pulps can be produced from the poplar species available in Alberta or B.C. In Canada, as well as worldwide, virtually all semichemical pulp is produced and consumed in integrated mills producing corrugating medium. International trade in this product is negligible with only approximately 2% of the world production sold in international markets. Consequently, as a market commodity, semichemical pulp is eliminated from further investigation.

Considerable interest is being shown at present in the market possibilities of mechanical pulps, particularly for bleached grades. These products are usually tailored to specific end-uses and, thus, require a wood supply which can permit a high degree of product flexibility. Rather extensive research has been carried out in recent years in utilization of hardwood for a variety of mechanical pulps. Both laboratory tests and commercial production show that some grades of mechanical pulp produced from aspen could be used in a variety of paper and paperboard products (for description of technical feasibility - see Appendix 2). Hence, some grades of mechanical pulp could be produced in Alberta and B.C. The market prospects for such products will be addressed later in this report.

Dissolving and special alpha pulps are highly purified grades of chemical pulp composed of 95 to 99% cellulose. These pulps are used to produce man-made fibres (rayon and acetate), films (cellophane), plastics (cellulose acetates) and chemicals (methyl cellulose and carboxylmethyl cellulose). Hence, with the exception of some specialty grades, the bulk of dissolving chemical pulp is utilized outside of the paper industry. In fact, about 80% of the total dissolving pulp shipments is destined for viscose products such as rayon for textiles and tire cord.

According to the technical feasibility evaluation prepared by Econotech, high quality acetate and viscose pulps can be successfully produced from aspen and cottonwood. There are, however, economic and marketing factors which limit the potential production of this grade of pulp in Alberta and B.C. In recent years, dissolving pulp producers have been hurt by sharp cost escalation for wood and energy and, at the same time, by growing acceptance of lower cost synthetic fibres and films. Rayon staple, for example, has been under heavy competitive pressure from polyester, while plastic films such as oriented polypropylene have been displacing cellophane. Consequently, dissolving pulp production in the United States (U.S.) has declined from a peak of around 1.6 million tonnes in the mid 1970's to 1.2 million tonnes in 1981. Canadian dissolving pulp production has followed a similar trend, declining from a peak of 450,000 tonnes in 1969 to 238,000 tonnes in 1981. Tembec Inc. in Temiscaming, Quebec and Western Forest Products Ltd. in Port Alice, B.C. are the only two dissolving pulp mills remaining in Canada, with a total annual capacity of 224,000 tons.

According to ITT Rayonier, the largest North American producer of dissolving pulp, chemical cellulose products are expected to grow at an annual average growth rate of only 1% during the 1980's. On a tonnage basis, most of this growth is expected to be in regular rayon staple, principally in demand from Asia. Demand for other grades is projected to remain stable with the exception of cellophane for which demand is expected to continue to decline. Based on the aforementioned factors, dissolving pulp is not considered a promising product for Alberta and the B.C. interior at this time. However, it is recommended that future development for this grade of pulp be closely monitored and re-evaluated at a future date.

Among the three major categories of paper and paperboard grades, i.e., newsprint, printing and writing papers and other paper and paperboard products, newsprint stands out as the most practical product, both in terms of the technical suitability of the fibre resource and the opportunity to place large volumes on the market. Technical studies and pilot tests conducted in North America and Scandinavia confirm that a substantial portion of newsprint furnish can be made from aspen mechanical pulp. Extensive trials conducted by CIC* in Saskatchewan showed that, with a small addition of chemical pulp in the furnish, aspen-based newsprint was suitable for all three major printing processes commonly used in the North America newspaper industry i.e., letterpress, offset lithography and direct lithography. Technical suitability of aspen in newsprint production was also confirmed in tests carried out by CIP Research Ltd. Hence, newsprint has been selected as a potential product for further investigation.

For merchandising reasons, the production of conventional printing and writing papers for job printing and for corporate and personal communication requires the production of a wide range of grades in terms of basis weight, finishes, colours and sizes. This variety presents a serious marketing and distribution problem. There are, however, several grades that might be made in volume and sold as a commodity in the open market. Some of these grades are best made with a substantial component of hardwood pulp and will be investigated in this project.

Among the remaining paper and paperboard categories, sanitary papers have shown strong growth, but they are consumer-oriented products which require producers such as Scott, Kimberly-Clark and Proctor and Gamble to engage in both paper manufacturing and paper converting operations and to mount strong promotional programs for their products. The nature of the products in terms of their volume to weight ratio does not permit the movement of sanitary papers on a major scale in international trade and therefore, a high dependence would have to be placed on the North American market, with competition from entrenched and highly competent companies. Technically, the poplar resources of Alberta and the B.C. interior are suited to this type of product but, in order to provide a full range of grades in the lower price bracket, considerable amounts of waste fibre would be necessary as furnish.

Linerboard suffers because of the limited domestic market and the very strong position which the southern U.S. producers occupy. The relative position of virgin liner in the European market is shrinking in the face of the growth of bogus liners. Furthermore, the developing world is unlikely to place significant demands for imported supplies owing to the structure of their marketing and distribution systems for products generally packaged in corrugated containers. They too will place greater stress upon bogus, low cost containers. Furthermore, the potential for utilization of poplar in linerboard is very poor due to its low strength characteristics.

Unbleached paper grades include multiwall sack paper, grocery bag paper and wrapping paper. These are industrial grades to which the remarks made in respect to linerboard also apply. Aspen is not suitable for production of industrial grades and can only be used as a minor component in the furnish.

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*For explanation of terms and abbreviations, see Appendix I.

Although aspen is known to produce good quality corrugating medium, this grade of paperboard, as a single product, is not recommended for further investigation. Markets logically accessible from Alberta and the B.C. interior are limited and would not absorb the quantities produced by a large scale operation. As in the case of linerboard, corrugating medium from virgin fibre competes against the low cost, waste paper-based flutings which are perfectly acceptable in most international markets.

Solid bleached kraft paperboard is made principally for folding cartons and milk carton stock. A small amount is used for linerboard. Bleached boards are produced in a wide range of calipers and basis weights and in three levels of apparent density. About half of the tonnage is coated. Most of the nearly 3.5 million tonnes consumed in the U.S. is produced by 16 companies having a productive capacity of about 4.3 million tonnes and long experience in the business. Solid bleached foodboard is not considered to be a candidate product because of the probable high cost of production and the extent of the technological skills required for the manufacture of the range of products comprising the group.

Specialty papers, which include grades such as greaseproof, glassine and insulating papers, have highly specialized uses and are consumed in limited quantities. They are, therefore, eliminated from further analysis.

However, on the basis of the hardwood species found in Alberta and B.C., but without consideration of volume and quality of fibre available at any specific location, and taking into account market related constraints, the following pulp and paper products have been selected for further investigation in this study:

- bleached sulphate hardwood market pulp;
- mechanical market pulp;
- newsprint;
- printing and writing paper.

PULP - WORLD OVERVIEW

General

Pulp is generally classified in terms of its method of preparation, which in turn implies the degree of purity of the pulp or the extent to which non-cellulose components of the original wood have been removed. The basic pulp grades are usually termed chemical, semichemical, chemi-mechanical and mechanical. Mechanical pulps are produced either by grinding wood billets (stone groundwood pulp) or by refining pulpwood chips. These pulps are produced at yields of 90% - 96% and are used mainly in the manufacture of newsprint and other low cost publication papers. They are usually made from softwood species, although an equivalent grade of pulp can be made from certain hardwood species by a chemi-mechanical process involving the treatment of the hardwood with chemicals and heat prior to grinding or refining.

The manufacture of mechanical pulp through the refining of chips is a relatively recent development which has evolved from the refining of chips at atmospheric pressure to result in a refiner mechanical pulp (RMP) or refiner groundwood pulp (RGP). The technology has developed to permit refining under pressure and elevated temperatures to produce a stronger pulp, thermomechanical pulp (TMP); and further, through the addition of chemicals in the refining process to produce, with less power, strong pulps such as chemi-mechanical pulp (CMP) or chemi-thermomechanical pulp (CTMP). These pulps have found increasing use as substitutes for chemical pulp and stone groundwood pulp in a variety of grades of paper and paperboard.

Chemical pulps are produced by cooking pulpwood chips in the presence of chemicals. These pulps are produced at yields ranging from 30 to 70% and have a wide variety of uses including conversion to cellulose-based fabrics and films (dissolving pulps), manufacture of high quality printing and writing papers (bleached paper and specialty grade pulps), and manufacture of bag papers, container boards, and special industrial papers (unbleached paper and board grade pulps). Chemical pulps are usually made by one of the two basic processes: the sulphite process involving the use of an acid-base cooking liquor, or by the sulphate, or kraft, process involving the use of an alkaline-base cooking liquor. The resulting pulps may be used as cooked (unbleached) or may be further purified by bleaching processes.

Sulphite pulp is used mainly in a variety of communication papers. Unbleached sulphite pulp finds its use predominantly in newsprint, whereas bleached sulphite pulp grades are major components of high quality printing and writing papers. For any given species of wood, sulphite pulp has a higher yield and is easier to bleach than sulphate pulp, but its strength properties are inferior. Due to its inherent strength characteristics, sulphate pulp in unbleached form is used mainly in packaging products, whereas bleached pulps are usually added as strength components to the furnish of a wide variety of paper and paperboard grades.

The sulphite process is still applied primarily to the coniferous species, such as spruce and balsam. However, some hardwoods such as poplar and eucalyptus are used in commercial production of sulphite pulps. On the other hand, the sulphate process offers far greater versatility in terms of wood species that can be successfully used as raw materials. In fact, virtually any wood can be pulped by the sulphate process. However, there are significant differences in the physical properties of the pulp fibres obtained from different tree species. Sulphate pulps manufactured from softwoods of low resin content, such as spruce, hemlock, and balsam fir, contain long, relatively slender, easily bleached fibres that are highly valued for papermaking. High resin content softwoods, such as most pines, yield a high strength fibre that is relatively coarse and is less suitable for fine papers, thin papers, or premium paper products requiring softness and high absorbency.

Pulp from hardwoods, such as eucalyptus, birch, poplar, beech and maple, are short-fibred pulps. The average length of fibres in mature hardwood is about 1.0 to 1.9 millimetres, whereas most softwood fibres range in length from 2.5 - 6.0 millimetres. Hardwood pulps produce paper with low strength, but exhibit valuable characteristics such as higher bulk, improved surface smoothness, and superior printing qualities.

Semi-chemical pulps are produced at yields ranging from 60 - 80% by cooking chips in liquor which may be acid, neutral, or alkaline, depending on the process. The cooked chips are subsequently separated into individual fibres by mechanical forces in refiners. Semi-chemical pulps may be produced from both hardwood and softwood species, and are used mainly in the manufacture of container boards and building boards. A good example is corrugating medium or fluting, used in the manufacture of corrugated boxes, which is made from hardwood by a neutral sulphite semichemical (NSSC) process.

Consumption Trends

The demand for pulp, in terms of type and volume, depends ultimately on the demand for individual paper and paperboard grades. The pulp furnish for any given type of paper or paperboard differs from region to region, as well as from mill to mill within a region. Although there may be technical reasons for some of the differences, pulp furnish ratios are heavily influenced by economic factors. The papermaker's art includes the ability to substitute recycled pulp for virgin pulp, hardwood for softwood pulp, or mechanical pulp for chemical pulp, and to use fillers such as clay, chemical additives, and surface treatments. Within limits, such substitutions can be made in response to the relative availability and cost of materials with little impact on the quality and utility of the papers. Furthermore, there are substantial differences in the quality of the same type of paper and paperboard that is consumed in different countries and regions. Table I shows the typical furnish ratios for the utilization of pulp in paper and paperboard products.

TABLE I

TYPICAL FURNISH RATIOS

(percent of furnish)

Product	Mechanical Pulp	Chemical Pulp		Recycled Pulp	Other
		Softwood	Hardwood		
Newsprint	75-90	25-10		De-inked newsprint may be substituted for up to 100% of the virgin pulps.	May contain fillers such as clay to enhance print characteristics.
Fine Papers (Wood Free)	less than 10	20-50	80-50	)	May also contain 10 - 30% inert fillers such as clay, or be coated or finished in a variety of ways to make it suitable for virtually all types of printing.
Groundwood Printing Papers	25-75	75-25		)	
Sack Kraft		100			
Folding Boxboard:					
Bleached, Europe	40-60	60-40			) Usually coated
Bleached, U.S.		60-100	40-0		)
Paperstock		0-20	100-80		)
Linerboard:					
Kraft		80-100	20-0	20-0	
Testliner		20 or more		80 or less	
Corrugating Medium			0-80	100-20	
Milk Carton Stock		100			

In each geographical region, there is a clear relationship between the types of pulp consumed and the local supply of papermaking raw materials. As Table 2 indicates, recycled fibre pulps are used extensively in Europe and other regions where shortages of fibrous plant material persist. Latin America uses a high percentage of recycled fibre and also produces substantial quantities of bagasse pulps, a natural outgrowth of the region's extensive sugar cane production. In Asia, other fibre pulps are used rather extensively. In 1980, pulps made from fibres such as reeds, straw, bamboo, bagasse, kenaf and grasses provided about 14% of the total fibre consumed in papermaking in Asia.

In recent years, consumption of papermaking fibres in North America and western Europe combined accounted for about 66% of the world total. However, this share is expected to decline by 4% over the next 15 years or so, reflecting the continuous shift in global distribution of paper and paperboard production.

TABLE 2 PULP USED IN PAPERMAKING, 1980

	Wood Pulp		Non-Wood Pulp		Recycled Pulp		Total Pulp	
	(thousand tonnes)	(%)	(thousand tonnes)	(%)	(thousand tonnes)	(%)	(thousand tonnes)	(%)
North America	58,509	79.7	600	0.9	14,270	19.4	73,379	100.0
Western Europe	29,482	66.1	707	1.6	14,430	32.3	44,619	100.0
Eastern Europe	4,187	68.7	108	1.8	1,800	29.5	6,095	100.0
U.S.S.R.	7,445	74.5	375	3.8	2,166	21.7	9,986	100.0
Latin America	4,425	50.3	757	8.6	3,611	41.1	8,793	100.0
Africa	1,035	60.0	145	8.4	545	31.6	1,725	100.0
Asia	15,494	48.6	4,419	13.8	12,000	37.6	31,913	100.0
Oceania	1,711	73.1	7	0.3	623	26.6	2,341	100.0
World	122,288	68.4	7,118	4.0	49,445	27.6	178,851	100.0

Source: Stanford Research Institute (SIR), 1982

A substantial growth in pulp consumption is expected to satisfy future demand for paper and paperboard products. We project that world consumption of paper grade pulp will increase from 129 million tonnes in 1980 to approximately 166 million tonnes in 1990, reflecting an average annual growth rate of 2.5%. This projection, as well as other published projections, are summarized in Table 3.

TABLE 3 WORLD DEMAND FOR PAPER GRADE PULP

(million tonnes)

	Organization	1980	1985	1990
1.	FAO/IWP, 1977	135	-	185
2.	FAO/Forestry Department, 1978	136	-	198
3.	Stanford Research Institute, 1981	-	148	168
4.	Stanford Research Institute, 1982	-	145	164
5.	Sandwell, 1982	-	148	166

Current and future world consumption for papermaking fibre by type is shown in Table 4.

TABLE 4 WORLD DEMAND FOR PAPERMAKING FIBRE

Furnish Component	1980		1990		1995	
	(million tonnes)	(%)	(million tonnes)	(%)	(million tonnes)	(%)
Mechanical/Semichemical	34.7	19.4	47.9	21.0	54.2	21.3
Unbleached Sulphate	33.8	18.9	41.1	18.0	44.9	17.6
White Chemical Pulps*	53.8	30.1	64.9	28.5	71.0	27.9
Paper Grade Wood Pulp	122.3	68.4	153.9	67.5	170.1	66.8
Non-Wood Pulp	7.1	4.0	10.0	4.4	11.6	4.6
Total Paper Grade Pulp	129.4	72.4	163.9	71.9	181.7	71.4
Waste Paper	49.4	27.6	64.1	28.1	72.8	28.6
Total Papermaking Fibre	178.8	100.0	228.0	100.0	254.5	100.0

Source: SRI, 1982.

*White chemical wood pulp includes bleached and semi bleached kraft pulp and both bleached and unbleached sulfite wood pulp. Unbleached sulfite wood pulp is a relatively white pulp that competes with bleached and semibleached kraft pulp in some applications such as newsprint production.

Mechanical and semichemical pulp is expected to improve slightly its share of the total fibre used in papermaking from 19 to 21% during the period 1980-1995, while unbleached sulphate and white chemical pulps are projected to decline gradually from 19% and 30% in 1980 to 18% and 28% respectively in 1990. Higher utilization of waste paper and relative changes in paper and paperboard product mix are major reasons for this decline.

Historically, non-wood pulps (pulps made from reeds, bagasse, straw, etc.) comprised about 4 - 5% of the total papermaking fibre and this ratio is not expected to change substantially, at least until 1995.

Capacity

Trends in paper grade pulp capacity by major type and world regions are examined in this section. Statistical data are based on the FAO Pulp and Paper Capacity Survey, published in 1982.

Past experience has shown that a number of projects included in the survey, particularly in regions such as Latin America, Africa and Southeast Asia, may be postponed or abandoned for reasons ranging from high cost to political instability. Consequently, future capacity data, especially towards the end of the survey period, may be overestimated.

As shown in Table 5, total paper grade wood pulp capacity is expected to increase from 139 million tonnes in 1980 to 157 million tonnes in 1986, an increase of approximately 17 million tonnes. This increase is equivalent to an annual average growth rate of 2.0%. Chemical wood pulp will account for 10.7 million tonnes of the increase, semichemical pulp for 0.7 million tonnes and mechanical pulp for 6.1 million tonnes.

TABLE 5 WORLD PAPER GRADE PULP CAPACITY - BY GRADE

	Capacity 1980 (million tonnes)	Capacity 1986 (million tonnes)	Increase 1980-1986 (million tonnes)	Average Annual Growth Rate 1980-1986 (%)
Mechanical	33.6	39.7	6.1	2.8
Semichemical	10.4	11.1	0.7	1.1
Chemical	95.4	106.1	10.7	1.8
Paper Grade Wood Pulp	139.4	156.9	17.5	2.0
Non-Wood Pulp	11.6	13.1	1.5	2.1
Total Paper Grade Pulp	151.0	170.0	19.0	2.0

Source: FAO, Capacity Survey 1982.

The same survey indicates a continuing reduction in the ratio between total paper grade pulp and total paper capacity. This ratio is expected to decline to about 75% in 1986 from 76.3% in 1980 and 80.5% in 1970. Higher utilization of waste paper and changes in the relative proportion of production of individual paper and paper board grades are major contributing factors for this phenomenon.

On a regional basis, the largest net increase is estimated to occur in North America and, as a consequence, this region will maintain its share of the total world capacity over the period 1980-1986 (see Table 6). However, regions such as Africa, Latin America, Asia (excluding Japan) and Oceania are expected to experience the largest average annual capacity growth rates.

TABLE 6 WORLD PAPER GRADE PULP CAPACITY - BY REGIONS

Region	Capacity				Net Increase 1980-86	Average Annual Growth Rate 1980-86
	1980*		1986			
	(million tonnes)	(%)	(million tonnes)	(%)	(million tonnes)	(%)
U.S.	47.1	33.8	52.7	33.6	5.6	1.9
Canada	21.5	15.4	24.3	15.5	2.8	2.1
Scandinavia	20.3	14.5	21.4	13.6	1.1	0.9
Western Europe**	10.9	7.8	12.0	7.7	1.1	1.6
Eastern Europe***	14.3	10.3	16.5	10.5	2.2	2.4
Latin America	5.3	3.8	7.2	4.6	1.9	5.2
Africa	1.1	0.8	2.1	1.3	1.0	11.4
Japan	12.6	9.0	12.7	8.1	0.1	0.1
Asia & Oceania****	6.3	4.6	8.0	5.1	1.7	4.1
Total	139.4	100.0	156.9	100.0	17.5	2.0

Source: FAO, Capacity Survey, 1982.

*1980 in FAO figures is a base year aggregate of 1979, 1980 and 1981.
**Excluding Scandinivia
***Including U.S.S.R.
****Excluding Japan

Production

Historic and projected production of paper grade wood pulp by major world region are presented in Table 7. Projections by SRI indicate that the largest growth in production will occur in North America where an increase of 18.4 million tonnes is forecast for the period 1980-1995, followed by western Europe where production is estimated to increase by 6.8 million tonnes over the same period.

In terms of individual grades, world production of mechanical and semichemical pulps is forecast to increase by approximately 19 million tonnes in the period 1980-1995, unbleached sulphate by 11 million tonnes, while white chemical pulp is projected to increase by 17 million tonnes over the same period of time. As expected, the largest increases in production of each grade will occur in countries of the northern hemisphere.

TABLE 7

WORLD PRODUCTION OF PAPER GRADE WOOD PULP

(million tonnes)

Region	Mechanical and Semichemical			Unbleached Sulphate			White Chemical			Total Paper Grade Wood Pulp		
	1980	1990	1995	1980	1990	1995	1980	1990	1995	1980	1990	1995
North America	15.8	21.4	23.8	19.5	22.2	23.4	29.0	33.2	35.4	64.2	76.8	82.6
Western Europe	9.9	12.4	13.6	4.9	5.5	5.8	11.4	12.9	13.6	26.2	30.8	33.0
Eastern Europe	0.9	1.2	1.4	1.0	1.2	1.4	1.4	2.1	2.3	3.2	4.6	5.2
U.S.S.R.	2.0	2.9	3.3	3.6	5.1	6.0	2.4	3.5	4.0	8.0	11.5	13.3
Latin America	0.6	1.3	1.8	1.7	2.2	2.8	2.7	4.0	4.9	5.1	7.5	9.5
Africa	0.5	0.6	0.7	0.4	0.7	0.8	0.2	0.8	1.0	1.1	2.0	2.6
Asia	3.8	6.1	7.1	2.9	3.7	4.3	5.8	7.4	8.2	12.5	17.2	19.6
Oceania	1.1	1.9	2.3	0.4	0.7	0.8	0.3	0.6	1.0	1.9	3.1	4.0
World Total	34.6	47.8	54.0	34.3	41.5	45.3	53.3	64.4	70.4	122.2	153.6	169.7

Source: SRI, 1982.

International Trade

International pulp trade is dominated by a limited number of producers primarily located in Scandinavia, North America and Brazil. Pulp exports from the major producing countries are shown in Table 8. In aggregate, these countries account for 80 - 90% of inter-regional world trade in pulp.

TABLE 8 WOOD PULP EXPORTS FROM MAJOR PRODUCING COUNTRIES, 1980

(thousand tonnes)

	To						
From	Europe	North America	Latin America	Africa	Japan	Other Asia/ Oceania	Total
Canada	2,236	3,354	80	38	809	336	6,853
U.S.	1,279	93	358	98	443	338	2,609
Sweden	2,741	9	7	63	84	148	3,052
Finland	1,608	18	5	37	51	174	1,893
Norway	369	-	-	3	1	1	374
Brazil	429	68	47	12	189	39	784
Total	8,662	3,542	497	251	1,577	1,036	15,565

Source: CPPI

As will be discussed later in this report, pulp export figures do not necessarily match those for market pulp export shipments due to differences in classification and other factors.

Wood pulp sales are heavily concentrated in Europe, North America and Japan. Exports to countries within these regions account for close to 90% of the international trade. Major trade flows centre on Scandinavian exports to western Europe, North American exports to western Europe and Japan and, in particular, Canadian exports to the U.S. Chemical pulps account for approximately 80% of the international pulp trade and approximately 60% of the trade is in bleached sulphate pulp.

Important shifts in the quantity and direction of white chemical pulp trade flows are shown in Table 9. Canada and the Scandinavian countries are expected to continue to dominate the paper grade wood pulp exports. Canada is in good position to expand exports but the rate of growth in additional capacity may be restricted by wood and capital availability constraints. Latin America and particularly Brazil, as well as some African countries, are expected to export substantial quantities of paper grade wood pulp despite increasing demand for pulp by their own papermaking industry.

TABLE 9 PAPER GRADE WOOD PULP - NET TRADE

(thousand tonnes)

Region	1970	1980	1990	1995
Canada	-4,706	-6,808	-7,882	-8,677
U.S.	1,004	1,052	1,303	1,203
Scandinavia	-6,016	-4,806	-5,445	-5,483
Other Western Europe	7,891	8,098	9,370	9,884
Eastern Europe	523	959	744	781
U.S.S.R.	-160	-532	-520	-551
Latin America	497	-620	-852	-976
Africa	-1	-71	-353	-503
Japan	751	1,826	2,904	3,952
Other Asia	511	1,215	1,324	1,316
Oceania	225	-195	-273	-626

Source: SRI, 1982.

Note:- Denotes net export.

Japan and western Europe (excluding Scandinavia), but particularly the EEC countries, will continue to be major pulp importers. In Japan, the high cost of imports of softwood pulpwood and fuel is expected to create a situation where they look to other producers for their increasing pulp and paper requirements. In addition to Japan, the Peoples' Republic of China and South Korea will provide promising markets for paper grade wood pulp in Southeast Asia throughout the 1980's and first half of the 1990's. Although the EEC countries will increase imports of paper grade pulp, demand in the period 1980-1995 might be curtailed by slow economic growth and trends toward lower basic weight, particularly in packaging and, to a lesser degree, in some communication paper grades.

Oceania is expected to increase net exports of paper grade wood pulp substantially in the early 1990's.

MARKET PULP

General

Only about 20% of the total world wood pulp production is market pulp which is defined as wood pulp produced for sale in open markets rather than for captive use. Most pulp is made and consumed either at the same location or transferred to affiliated mills.

In many instances, there is little to distinguish a mill producing pulp exclusivey for its own requirements from a mill producing pulp for intra-company shipment or market pulp. Indeed, many mills produce pulp for all three purposes, shifting readily from one to another with changes in demand and prices. Such flexibility of integrated pulp and paper mills makes it impossible to distinguish clearly between market pulp and captive pulp production. This flexibility, as will be shown, also contributes to instability in markets for pulp and to volatile price changes.

Moreover, many mills can readily switch from hardwood to softwood grades and vice versa, and from bleached to semibleached or unbleached grades in response to market conditions. For these and other reasons, such as differences in market pulp definitions and the accuracy of reporting systems used by individual countries, international statistics on market pulps are limited, and those which are available should be treated with extreme caution.

As a consequence, projections of future demand/supply balance from public sources are scarce and, in general, unreliable, particularly those based on long term trend behaviour. The pulp market presents all the characteristics of a highly competitive commodity market and, as such, is very susceptible to the cyclical nature of macro-economic behaviour. Hence, any serious attempt to forecast future trends in demand/supply relationship for market pulp should take into account the effects of business cycles on individual grades.

Bleached Sulphate Hardwood Market Pulp

The primary objective of this section is to analyze the market potential for bleached sulphate hardwood pulp. However, because of a potential substitution of individual pulp grades in several paper products, it is necessary to analyze the supply/demand balance for market white pulps in order to establish the position of the grade under investigation.

As shown in Table 10, world paper grade market white pulp capacity is expected to increase from 22.1 million tonnes in 1981 to 23.4 million tonnes in 1984 and is estimated to reach 24.4 million tonnes in 1986, equivalent to an average annual growth rate of 2.0%. NORSCAN* countries will account for 1.0 million tonnes of this increase and the other countries for 1.3 million tonnes. As a consequence, NORSCAN capacity which accounted for 75% of the total capacity in 1981, will decrease to 72% in 1986.

TABLE 10 WORLD PAPER GRADE MARKET WHITE PULP CAPACITY

Item	Capacity			Increase	Average Annual Growth Rate
	1981	1984 (thousand tonnes)	1986	1981-86 (thousand tonnes)	1981-86 (%)
NORSCAN	16,575	17,100	17,600	1,025	1.2
Other Countries	5,490	6,250	6,800	1,310	4.4
Total World*	22,065	23,350	24,400	2,335	2.0

Sources: FAO, Sandwell.

*Excluding Eastern Europe and Peoples' Republic of China.

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*NORSCAN: The U.S., Canada, Sweden, Finland and Norway.

The distribution of NORSCAN market white pulp capacity by grade is demonstrated in Table 11. Bleached sulphate softwood capacity is expected to increase by 1.3 million tonnes in the period 1981-1986. In addition to a capacity increase of 395,000 tonnes, as reported by FAO for the 1981-1984 period in Scandinavia, we estimate a further modest capacity gain of 50,000 tonnes in this region by 1986. The balance in additional capacity will come from North America, especially from the U.S. Bleached sulphate hardwood market pulp capacity is expected to maintain its share of about 22% of the total, in spite of a 165,000 tonnes loss in Finland during the interim years. New capacity for this grade is forecast to be located primarily in the U.S. with a marginal increase in Canada. A striking feature is a continuous decrease in market sulphite pulp capacity which is projected to decline by 600,000 tonnes over the period under review. Both the bleached and unbleached sulphite grades will be affected in North America as well as in Scandinavia.

TABLE 11 NORSCAN MARKET WHITE PULP CAPACITY BY GRADE

Item	Capacity				Net Increase (Decrease)
	1981		1986		1981-86
	(thousand tonnes)	(%)	(thousand tonnes)	(%)	(thousand tonnes)
Bleached Sulphate Softwood Pulp	11,250	68	12,600	72	1,350
Bleached Sulphate Hardwood Pulp	3,625	22	3,900	22	275
Unbleached and Bleached Sulphite Pulp	1,700	10	1,100	6	(600)
All Grades	16,575	100	17,600	100	1,025

Sources: FAO, Sandwell.

The regional distribution of market white pulp capacity in other countries is shown in Table 12. Figures in this table are based on the FAO capacity survey* and on our current information. By 1986, a new mill in Argentina and possibly one in Guatemala should be operating at full capacity, Brazil will gain more bleached pulp capacity owing to conversion from unbleached pulp and by modest expansions in existing non-integrated mills. Chile is expected to follow the same pattern, with a change of about 50,000 tonnes from unbleached to bleached pulp, and an expansion of an existing mill.

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*"Pulp and Paper Capacities, 1981-1986," Food and Agriculture Organization of the United Nations, 1982.

The net capacity increase in western Europe is projected to be 480,000 tonnes in the period 1981-1986. Major contributors are three new mills either under construction or in operation in France, Portugal and Austria. Minor adjustments in market white pulp capacity are also expected to occur in Spain, France and Portugal owing to conversion from unbleached to bleached sulphate grade and a decline in sulphite bleached pulp.

The only other capacity addition of a notable size, which has been taken into account in this study, is 250,000 tonnes allocated to South Africa in 1986. This assumes that a part of the new mill capacity will be used internally. It is conceivable that by 1986 the market capacity of bleached sulphate pulp in South Africa will turn out to be even greater if the macro-economic environment improves in the near future.

TABLE 12 MARKET WHITE PULP CAPACITY IN OTHER COUNTRIES*

Item	Capacity 1981	Capacity 1984	Capacity 1986	Net Increase (Decrease) 1981-86 (thousand tonnes)	Average Annual Growth Rate 1981-86 (%)
	(thousand tonnes)				
Western Europe	2,380	2,790	2,860	480	3.7
Latin America	1,630	1,985	2,240	610	6.6
Japan	780	730	700	(80)	-2.1
Other	700	745	1,000	300	7.4
All Other Countries*	5,490	6,250	6,800	1,310	4.4

Source: FAO, Sandwell.

*Excluding eastern Europe and Peoples' Republic of China.

Table 13 shows the capacity for bleached sulphate softwood market pulp in countries other than NORSCAN as estimated by Sandwell. Capacity for this grade is projected to increase from 825,000 tonnes in 1981 to 1.8 million tonnes in 1986, equivalent to an average annual growth rate of 16.9%. This capacity increase of 975,000 tonnes represents almost 75% of the total additional white market pulp capacity in other countries over the period 1981-1986. This is a marked departure from the past trend in capacity growth in other countries, which showed a much higher growth rate in bleached sulphate hardwood pulp capacity than in softwood pulp. As a consequence, bleached sulphate softwood pulp capacity in other countries will increase its share of total white market pulp capacity from 15% in 1981 to 26% in 1986.

TABLE 13 BLEACHED SULPHATE SOFTWOOD MARKET PULP CAPACITY IN OTHER COUNTRIES*

Country	Capacity 1981	Capacity 1984	Capacity 1986	Increase 1981-86
	(thousand tonnes)			(thousand tonnes)
Austria	-	-	150	150
France	140	230	230	90
Portugal	20	105	145	125
Spain	120	120	120	-
Japan	105	105	105	-
South Korea	45	55	55	10
New Zealand	120	120	120	-
Argentina	-	135	170	170
Brazil	20	70	90	70
Chile	235	305	365	130
Guatemala	-	70	100	100
South Africa	20	20	150	130
Total	825	1,335	1,800	975

Source: FAO, Sandwell.

*Excluding eastern Europe and Peoples' Republic of China.

In global terms, however, the impact of a high growth rate in additional bleached sulphate softwood market pulp capacity in other countries will be less dramatic. As shown in Table 14, about 93% of the total bleached sulphate softwood market pulp capacity is currently located in NORSCAN countries, and only 7% in other countries. Although these proportions are projected to change to 86% and 14% respectively by 1986, it does not significantly alter the fact that NORSCAN producers will continue to dominate production and, consequently, world trade for many years to come.

TABLE 14

WORLD MARKET BLEACHED SULPHATE SOFTWOOD PULP CAPACITY

Region	Capacity 1981 (thousand tonnes)	Capacity 1981 (%)	Capacity 1986 (thousand tonnes)	Capacity 1986 (%)	Increase 1981-86 (thousand tonnes)	Average Annual Growth Rate 1981-86 (%)
NORSCAN	11,250	93	12,600	86	1,350	2.3
Other Countries*	825	7	1,800	14	975	16.9
Total	12,075	100	14,400	100	2,325	3.6

Source: FAO, Sandwell.

*Excluding eastern Europe and Peoples' Republic of China.

In 1981, NORSCAN countries produced 14.6 million tonnes of white market pulp, about 500,000 tonnes less than in previous years when this segment of the industry operated very close to its maximum potential production** level.

White market pulp shipments from NORSCAN to all markets totalled 14.1 million tonnes in 1981, a decline of approximately 700,000 tonnes over 1980. By the end of 1981, NORSCAN producers' inventories of white pulp increased to 1.3 million tonnes, reflecting further deterioration in demand.

The trend in declining shipments and a sharp rise in inventories, in spite of curtailed production, continued throughout 1982.

The trends in production and shipments for white market pulp in countries other than NORSCAN have followed a similar pattern, although the decline has not been as pronounced. Shipments from other countries decreased by only 2.3% in 1981 over 1980, as opposed to NORSCAN'S 4.6%.

**Potential production is a measure of maximum practical capacity utilization and is defined as follows: 95% of market pulp capacity in NORSCAN countries, 90% of capacity for western Europe and Japan, and 85% of capacity in other countries.

The total white market pulp supply/demand balance, based on the actual figures of 1981, and as projected by Sandwell for 1986, is shown in Table 15. Note that in terms of demand, the figures include exports from NORSCAN and also from the other countries to eastern Europe and to the Peoples' Republic of China. However, in terms of supply, shipments from eastern Europe to the rest of the world are excluded from this analysis because of unreliable data. The only consuming region where this obvious drawback might be of some importance is western Europe which reportedly imported in total about 165,000 tonnes in 1981. In our view, the exports from eastern Europe (especially from Czechoslovakia and the U.S.S.R.) to western Europe will increase to about 350,000 tonnes per annum within the time span under investigation.

Total demand, expressed as shipments to all world regions, for white market pulp amounted to 18.6 million tonnes in 1981, reflecting a drop of approximately 800,000 tonnes or 4% from the 1980 level. Projections indicate that the total demand for white market pulp will reach 22.3 million tonnes in 1986, which is equivalent to 99% of the maximum practical production the industry can achieve from capacity expected to be available in that year. Hence, the supply will be in balance with demand in 1986. The world economy is likely to peak again in 1986 and demand for pulp is expected to be at its peak by late 1986, after which it is projected to level off or, perhaps, decline moderately in 1987, according to forecasts made by Sandwell and Company.

As for the interim years, we expects a modest recovery in economic growth in 1983 from the 1982 level. The NORSCAN white market pulp segment of the pulp and paper industry is expected to have an operating ratio of about 82% in 1983 (a slight improvement from 80% estimated for 1982). In Sandwell's scenario, 1984 should show a significant increase in demand and, consequently, the operating ratios will increase to about 85%. As already mentioned, further improvement is expected in 1985-1986 when demand should drive the NORSCAN production close to its maximum potential level.

TABLE 15 TOTAL WHITE MARKET PULP SUPPLY/DEMAND BALANCE

Item	1981 (thousand tonnes)	1986 (thousand tonnes)	Increase 1981-86 (thousand tonnes)	Average Annual Growth Rates 1981-86 (%)
NORSCAN Countries				
Capacity	16,575	17,600	1,025	1.2
Maximum Potential Production	15,745	16,700	955	1.2
Shipments	14,150	16,450	2,300	3.1
Other Countries*				
Capacity	5,490	6,800	1,310	4.4
Maximum Potential Production	4,825	5,900	1,075	4.1
Shipments	4,475	5,800	1,325	5.3
World				
Capacity*	22,065	24,400	2,335	2.0
Maximum Potential Production*	10,570	22,600	2,030	1.9
Demand	18,625	22,250	3,625	3.6

Source: Sandwell.

*Excluding eastern Europe and Peoples' Republic of China.

Significant changes are also expected to occur in terms of future distribution in regional demand for white market pulp, as demonstrated in Table 16. As expected, only a modest increase in demand is projected for Canada, whereas the bulk of the increase, close to 800,000 tonnes, is projected to occur in the U.S. which, coincidentally, shows the highest increase in white market pulp capacity of all NORSCAN countries. A part of the capacity increase forecast for the U.S. will undoubtedly augment the capacity already in place. It is a well known fact that, when the U.S. paper and paperboard industry is running at full capacity, the availability of market pulp in the U.S., and, consequently in the world market, decreases at a rapid pace. Hence, it is possible that not all the white market pulp capacity addition projected for the U.S. in 1986 will, in fact, be available for pulp to be sold in open markets. This does not, however, alter the demand scenario for the U.S. which is based on the total fibre requirements. Whether or not the increase in white pulp demand will be supplied in a form of captive tonnage, or as market pulp from domestic sources, is irrelevant to this analysis.

Demand for white market pulp in western Europe is projected to increase by 825,000 tonnes in the 1981-1986 period reflecting an average annual growth rate of 1.8% which is the lowest of all regions. There are several factors which will cause a relatively slow growth in demand. Total paper and paperboard production in western Europe is projected to increase at an average growth rate of 2.0%. Production of printing and writing papers and tissue and sanitary products in which white market pulps find their principal use is projected to increase at an average annual growth rate of 2.1% and 3.0%, respectively, over the same period of time.

TABLE 16 DEMAND FOR WHITE MARKET PULP BY MAJOR REGIONS

Region	Demand				Increase (Decrease)	Average Annual Growth Rate
	1981		1986		1981-86	1981-86
	(thousand tonnes)	(%)	(thousand tonnes)	(%)	(thousand tonnes)	(%)
North America	4,850	26.0	5,800	26.1	950	3.6
Scandinavia	835	4.5	700	3.2	(135)	-3.5
Western Europe	8,625	46.3	9,450	42.5	825	1.8
Latin America	670	3.6	1,200	5.4	530	12.4
Japan	1,500	8.2	2,300	10.3	800	8.9
Asia/Africa*	1,650	8.8	2,200	9.9	550	5.9
Oceania	195	1.0	300	1.3	105	9.0
Eastern Europe	300	1.6	300	1.3	-	-
Total	18,625	100.0	22,250	100.0	3,625	3.6

Source: Sandwell.

*Excluding Japan but including the Peoples' Republic of China.

It is recognized that a number of mills producing printing and writing papers in western Europe are currently either closed down or close to bankruptcy. However, due to expected economic recovery and possible governmental intervention, at least some of these mills (e.g., Van Gelder in the Netherlands and some French mills) will continue to operate during the period under review. This, coupled with the expected continuous high operating rates in West German mills due to increased exports, is one of the major factors for the projected increase in demand for white market pulp.

The negative growth in demand for white market pulp in Scandinavia reflects primarily the further integration in the pulp and paper industry in this region.

Major demand growth for white market pulp is expected in Latin America, especially in Brazil, Mexico and, to a lesser degree, Venezuela. However, the potential production from expected capacity expansions in this region as a whole might almost entirely offset the incremental demand.

The bulk of the increase for white market pulp demand in Japan will be in the bleached sulphate softwood grade since Japan is deficient in long fibre raw material and imports of softwood pulpwood are becoming too costly for domestic pulp production. An offsetting factor for demand is the trend towards lightweight grades of paper and expected further increases in utilization of de-inked pulp.

Aside from Japan, the most promising markets for white market pulp in Southeast Asia in the period under investigation, are to be found in South Korea, The Peoples' Republic of China, and, to a lesser extent, Indonesia and Thailand. Based on recent comments from Chinese agencies governing the pulp and paper industry, this analysis assumes that white pulp imports to the Peoples' Republic of China will average about 200,000 tonnes per year in 1982-1984 and about 350,000 tonnes in 1985-1986.

As in the past, most of the incremental demand for Oceania is projected to occur in Australia. This scenario assumes that no major white market pulp capacity increase in this region will take place within the time frame under review.

In spite of new market pulp capacities coming on stream in eastern Europe in the near future, it is our view that the imports to this region will, on average, remain basically at the same level as in 1981.

Bleached sulphate hardwood pulp is currently utilized in a wide variety of paper and paperboard, especially where high strength is not a primary consideration. Because of its inherent characteristics, short fibre sulphate pulp finds its major use in coated and uncoated fine papers where it enhances required qualities such as opacity, bulk, etc. This grade of pulp is also used in tissue and sanitary products, other grades of cultural papers, bleached board, business forms and other specialty papers. As has already been mentioned, the furnish for individual paper and paperboard products varies from mill to mill and from region to region, depending on type of fibre available, desired quality characteristics of the end-products and economic considerations. It is a well known fact that in times of depressed demand conditions, the premium northern grades of softwood pulp tend to lose ground to cheaper hardwood pulp grades and vice-versa. Concurrently, cheap virgin hardwood pulps also replace some waste paper in the furnish of many products when the market is depressed. Hence, the relative proportions of furnish components in paper and paperboard are also influenced by business cycles.

The types of hardwood pulp currently available on major markets can be divided into the following categories:

1. Birch - Predominantly from Scandinavia.
2. Eucalyptus - Predominantly from Portugal, Spain, Morocco and Brazil.
3. Central European Hardwoods - Hardwoods from Continental Europe, with beech the dominant species.
4. Southern U.S. Hardwoods - Hardwoods from the U.S. south based, predominantly, on oak and gums.
5. Northern American Hardwoods - Hardwoods from the northeast region of North America, predominantly maple, birch, beech and aspen.

6. Mixed Tropical Hardwoods - Some tropical hardwood species are pulped in Asia (e.g., Philippines), Latin America and West Africa. However, only Cellulose du Cameroon S.A. is currently producing market pulp from mixed tropical hardwood species.

Traditionally, bleached birch pulp from Scandinavia has been the preferred hardwood pulp, particularly when some strength is required in combination with good formation and surface properties. However, non-traditional hardwood pulps, such as eucalyptus and mixed tropical hardwood pulps, have gradually increased their status and are now well-recognized for their own unique properties and consequently are well-established on world markets. For example, the combined production of chemical paper grade market pulp made from eucalyptus in Brazil, Portugal, Spain and Morocco increased from 360,000 tonnes in 1970 to 1.94 million in 1981, reflecting an average annual growth rate of 18.3%. In comparison, the NORSCAN chemical hardwood market pulp production increased from 2.63 million tonnes to 3.17 million tonnes over the same period of time which reflects average annual growth rate of 1.7%. In terms of technical suitability, bleached hardwood sulphate pulp made from aspen is expected to be equivalent to the birch pulp in some applications and at least as good as the European beech pulp in all paper and paperboard products.

As Table 17 demonstrates, world bleached sulphate hardwood market pulp capacity is projected to increase from 7.4 million tonnes in 1981 to 8.2 million tonnes in 1986, equivalent to an average annual growth rate of 2.0%. Figures shown in Table 17 are based on current information available to Sandwell. It should be noted that the capacity figures for Brazil in 1981 include capacity of unbleached kraft pulp produced by Riocell which is currently bleached in Norway but will be bleached in Brazil starting 1983, and also a swing capacity for market pulp sold by integrated mills. This adjustment is necessary to avoid double counting in the supply/demand balance and also helps to reconcile figures for domestic and export shipments of bleached hardwood pulp in Brazil. A similar adjustment was made for Taiwan where the capacity figure for 1986 includes capacity under construction in Indonesia but considered captive to Taiwanese paper producers.

In terms of NORSCAN countries, the bulk of additional capacity is projected to come on stream in the U.S.

The U.S. estimate includes two new mills (Leaf River Co., Hattiesburg, Ms. and Champion International Co., Quinnesoc, Mi.) and an expansion (Hammermill Paper Co., Selma, Al., etc.). Other U.S. suppliers known to be planning additional capacities are Alabama River Pulp Co., James River Co., Kimberly-Clark, Brunswick Pulp and Paper Co., etc. Due to lack of firm commitments, these planned capacities have not been taken into account in the figures shown in Table 17.

An expansion of E.B. Eddy Forest Products Ltd., in Espanola, Ont., accounts for the bulk of the increase in Canadian capacity. Scandinavian countries are expected to experience a decline, entirely due to further integration. A new mill in Portugal is a major contributor to bleached hardwood market pulp capacity in western Europe, other than Scandinavia, with minor expansions taking place in France and the Benelux countries. A new mill under construction in South Africa is expected to contribute about 80,000 tonnes to the world's bleached hardwood market pulp capacity. It is projected that new mills planned in some other African countries such as Gabon, Ivory Coast, etc., will not be built within the time frame under review.

TABLE 17 WORLD BLEACHED SULPHATE HARDWOOD MARKET PULP CAPACITY*

	Capacity 1981 (thousand tonnes)	Capacity 1986 (thousand tonnes)	Increase (Decrease) 1981-86 (thousand tonnes)	Average Annual Growth Rate 1981-86 (%)
Canada	635	680	45	1.4
U.S.	1,615	2,010	395	4.5
Finland	805	655	(150)	-4.0
Sweden	570	555	(15)	-0.5
NORSCAN	3,625	3,900	275	1.5
Benelux	207	240	33	3.0
France	290	340	50	3.2
Portugal	520	630	110	3.9
Spain	340	340	-	-
Western Europe	1,357	1,550	193	2.7
Brazil	1,340	1,480	140	2.0
Latin America	1,340	1,480	140	2.0
Japan	595	595	-	-
South Korea	45	50	5	2.1
Cameroon	60	70	10	3.1
Morocco	95	95	-	-
New Zealand	10	10	-	-
South Africa	15	100	85	46.1
Taiwan	290	350	60	3.8
Other Asia/Africa/Oceania	515	675	160	5.6
All other Countries	3,807	4,300	493	2.5
World Total	7,432	8,200	768	2.0

Source: Sandwell.

*Excluding eastern Europe and Peoples' Republic of China.

The supply/demand balance for bleached hardwood sulphate pulp is presented in Table 18. This balance is based on the same set of assumptions and constraints (including the macro-economic senario) as the supply/demand balance for white market pulps shown in Table 15.

TABLE 18 TOTAL BLEACHED SULPHATE HARDWOOD MARKET PULP SUPPLY/DEMAND BALANCE

	Capacity 1981 (thousand tonnes)	Capacity 1986 (thousand tonnes)	(Increase) 1981-86 (thousand tonnes)	Average Annual Growth Rate 1981-86 (%)
NORSCAN Countries				
Capacity	3,625	3,900	275	1.5
Maximum Potential Production	3,440	3,700	260	1.5
Shipments	3,040	3,700	660	4.0
Other Countries*				
Capacity	3,807	4,300	493	2.5
Maximum Potential Production	3,330	3,800	470	2.7
Shipments	3,110	3,800	690	4.1
World				
Capacity*	7,432	8,200	768	2.0
Maximum Potential Production*	6,770	7,500	730	2.1
Demand	6,150	7,500	1,350	4.1

Source: Sandwell.

*Excluding eastern Europe and Peoples' Republic of China.

World demand is projected to reach 7.5 million tonnes in 1986, an increase of 1.4 million tonnes over 1981. The corresponding average annual growth rate of 4.1% is slightly greater than the average annual growth rate of 3.6% projected for the total white pulp demand. As in 1981, approximately 50% of the world demand is projected to be supplied by NORSCAN countries in 1986.

The world's bleached sulphate hardwood market pulp segment of the industry is expected to operate at its maximum potential production level which corresponds to about 91% of the installed capacity in 1986.

On a regional basis, a modest increase in demand for bleached sulphate hardwood pulp is expected in North America (90% of which is in the U.S.) as illustrated in Table 19. Western Europe (excluding Scandinavia) is projected to continue to lose its share of the total demand for this grade from 52% in 1974 and 46% in 1981 to 41% in 1986. In spite of the decline, western Europe will remain by far the largest market for bleached hardwood pulp.

Latin America and Japan are projected to experience the largest average annual growth rates in the 1981-1986 period. It should be noted, however, that the demand in 1981 in both Latin America and Japan was substantially lower than in 1980 due to depressed economic conditions. Hence, the growth rates shown in Table 19 are not considered unrealistic.

Asia (other than Japan) and Africa combined is projected to further improve its share of the total demand from 5% in 1974 and 13% in 1981 to about 14% in 1986.

TABLE 19 DEMAND FOR BLEACHED SULPHATE HARDWOOD MARKET PULP BY MAJOR REGIONS

Region	Demand				Increase (Decrease)	Average Annual Growth Rate
	1981		1986		1981-86	1981-86
	(thousand tonnes)	(%)	(thousand tonnes)	(%)	(thousand tonnes)	(%)
North America	1,215	19.8	1,420	18.9	205	3.2
Scandinavia	245	4.0	230	3.1	(15)	-1.3
Western Europe*	2,840	46.2	3,100	41.3	260	1.8
Latin America	375	6.1	700	9.3	325	13.3
Japan	640	10.4	960	12.8	320	8.4
Asia/Africa**	780	12.6	1,030	13.8	250	5.7
Oceania	35	0.6	30	0.4	(5)	-3.0
Eastern Europe	20	0.3	30	0.4	10	8.4
Total	6,150	100.0	7,500	100.0	1,350	4.1

Source: Sandwell.

*Excluding Scandinavia.

**Excluding Japan but including The Peoples' Republic of China.

In 1981, Canadian shipments of bleached kraft hardwood market pulp amounted to 593,000 tonnes or approximately 10% of the total Canadian paper grade chemical market pulp shipments. By comparison, bleached kraft softwood market pulp accounted for 81% of the total Canadian market pulp shipments in the same year. There are at present seven mills producing bleached kraft hardwood market pulp, all located in eastern Canada. Three mills are located in the Great Lakes region of Ontario, whereas the remaining mills are located in Quebec and New Brunswick. Only about 200,000 tonnes of bleached kraft hardwood market pulp were shipped to domestic markets in 1981. The balance of 393,000 tonnes, which represented 66% of the total shipment, was destined for export. Export shipments from Canada to major markets have been estimated as follows:

	1980 (%)	1981 (%)
U.S.	32	38
Western Europe	41	40
Japan	19	17
Other Asia/Oceania	1	3
Latin America	4	1
Other	3	1
Total	100	100

Western Europe has traditionally been a large market for Canadian hardwood market pulp. It should be noted that shipments to western Europe contain some captive tonnage for delivery to affiliated companies. For a new mill in Alberta or the B.C. interior, western Europe does not appear to be a promising market because of the excessive transportation costs.

More promising markets would be those in the U.S., particularly in the north central and western regions. Hardwood sulphate pulps are produced predominately in the U.S. northeast and the south region with only a relatively small amount in the mid-west region. As in the case of Canada, the western part of the U.S. does not have a local supply of market bleached hardwood pulp. The market for aspen based bleached sulphate hardwood pulp could be developed in the aforementioned regions for the bulk of the production from a new mill in Alberta or the B.C. interior. It has already been established that this grade of market pulp is as good or better than standard North American mixed hardwood pulp in most applications. Because of its bulk and opacity characteristics, bleached kraft aspen pulp could potentially compete with eucalyptus bleached kraft pulp which is imported by the U.S. from Brazil, as illustrated in Table 20.

TABLE 20 BLEACHED SULPHATE HARDWOOD MARKET PULP SHIPMENTS TO AND FROM THE UNITED STATES

Item	1980 (thousand tonnes)	1980 (%)	1981 (thousand tonnes)	1981 (%)
Domestic shipments	700	-	708	-
Exports To:	673	100	690	100
Western Europe	359	53	398	58
Japan	141	21	110	16
Other Asia/Oceania	74	11	100	14
Latin America	75	11	46	7
Canada	7	1	15	2
Other	17	3	21	3
Imports From:	205	100	282	100
Canada	131	64	155	55
Brazil	66	32	118	42
Scandinavia	6	3	7	2
Other	2	1	2	1

Source: American Paper Institute (API)

The U.S. imports substantial quantities of bleached kraft hardwood pulp from two sources only, Canada and, in recent years, Brazil. In terms of exports, the bulk of bleached kraft hardwood market pulp is shipped to western Europe but a significant share of the total export is destined for Japan and other countries of Asia and Oceania (e.g., South Korea, Indonesia, China, Australia, etc.).

It is not inconceivable that a supplier located in Alberta or the B.C. interior could allocate a part of its production for sale in Japan or other Asian markets (e.g., South Korea). In 1980, Japan imported 410,000 tonnes of bleached kraft hardwood pulp, of which 48% originated in Brazil, 30% was imported from the U.S., 15% from Canada and the remaining 7% mainly from Scandinavia. It is interesting to note that all major suppliers from Canada and the U.S. are located further away from this market than would be a potential producer in the B.C. interior or Alberta. Distance from the market is not, however, the only variable in freight cost structure. Other factors such as product density, availability and frequency of service also affect transportation rates.

An analogy could be made vis-a-vis Brazil and Scandinavian producers and their distance from Asian markets. However, to determine a competitive position of individual suppliers in a given market, the full production cost (i.e., production cost plus transportation) ought to be taken into consideration, as well as product prices. Analysis of such factors would be the subject of a detailed feasibility study. Nevertheless, due to the current situation in demand/supply market pulp balance, some of the key factors which affect both supply and demand are discussed in broad terms hereafter.

Pulp prices on international markets are normally established by market pulp producers in Scandinavia and North America. Due to the competitive nature of pulp markets, coupled with the fact that pulp is sold worldwide in U.S. dollars, prices in major markets (western Europe, North America and Japan) are usually well correlated.

Under normal market conditions, prices for individual grades of market pulp are related to the price for premium grade bleached sulphate softwood pulp produced from northern species of wood in Scandinavia and North America.

The long-term historic price trend for pulp has little relevance in view of the price developments of the past several years. From 1960 through 1972, the price of bleached sulphate softwood pulp (CIF northern European ports) increased only about US$30 per tonne, reaching US$200 at the latter date. Commencing in the first half of 1973, strong demand for this grade of pulp pushed prices upwards to US$415 per tonne in the latter part of 1974, almost double the level in early 1973. Due to a general slowdown in economic activity and factors such as a gradual buildup of producers' inventories and increases in capacity, the price remained at this level until early 1977. By that time, the NORSCAN pulp producers' inventories reached almost 3.0 million tonnes - far in excess of the 1.2 - 1.5 million tonnes considered to be a normal level. The subsequent inventory liquidation, coupled with the impact of increased capacity (in 1977 alone, three new market pulp mills started up in North America and three more in Europe) and the worsening of a worldwide recession, led to a severe downward price adjustment during 1977 and the first half of 1978.

After bottoming in mid-1978 when the list price was US$330 per tonne (due to discounting, some tonnage was sold below US$300), prices rose for eight consecutive quarters reaching US$545 in April 1980. This price prevailed into the first quarter of 1982. In recent years, the currency exchange rates have dramatically affected both the revenues received by the producers in their national currencies and the prices paid by the consumers in their local currencies.

The list price in U.S. dollars for bleached softwood sulphate pulp increased by approximately 30% in the period 1977-1981. However, the actual prices expressed in currencies of major suppliers increased by 50 - 75% over the same period. Due to the decline in the Canadian dollar relative to the U.S. dollar, Canadian pulp suppliers enjoyed a marked competitive advantage over their Scandinavian counterparts, particularly in 1979 and 1980. However, due to strengthening of the U.S. dollar, the situation changed dramatically in the past two years when the Finnish, Norwegian and especially Swedish currencies declined by considerable margins relative to the U.S. dollar. This decline in exchange rates has had the same effect for Swedish exporters as raising the price of bleached softwood pulp from US$545 per tonne to about US$730 per tonne (without a change in list price of US $545 tonne).

Concurrently, the actual cost of pulp for major buyers such as West Germany, the United Kingdom and Japan was lower in January 1980 than at the beginning of 1977 due to the decline in the U.S. dollar in the period 1977-1980. Since the consumers were in effect obtaining large discounts during that period of time, they did not oppose the price increases in 1978 and 1979. However, the net effect of the strong performance of the U.S. dollar vis-a-vis other major world currencies in the first eight months of 1981 resulted in an increase of 25% in the actual cost of pulp for German consumers and an even higher increase in some other EEC countries such as France and Italy.

The continued strength of the U.S. dollar has contributed significantly to pulp price cutting throughout 1982. In particular, a devaluation of Swedish and Finnish currencies by 16% and 10%, respectively, in the second half of 1982, allowed the price for bleached sulphate softwood pulp to decrease to about US$410 per tonne by the end of 1982. No significant price recovery is expected before the third quarter of 1983, although some gradual improvement might occur during the early summer.

The performance of other market pulp grades in the international market has been even worse. The price for U.S. southern bleached softwood pulp has been discounted by more than US$100 per tonne in all markets, including western Europe. Bleached hardwood pulp has been discounted by even greater margins from its official level. The spread between list prices of bleached northern softwood pulp and other grades of market pulps has narrowed somewhat due to the aforementioned price reduction in northern grades.

Under normal market conditions, bleached kraft hardwood pulp is sold at US$20 - US$40 per tonne less than the premium bleached kraft softwood pulp. For example, prevailing prices for bleached kraft markets pulps in 1981 were as follows:

	US$/tonne cif W. Europe
Bleached softwood sulphate (premium Scandinavian and North American grades)	545
U.S. southern bleached softwood sulphate	530
Bleached hardwood sulphate, birch	520
Bleached hardwood sulphate, eucalyptus	515
Bleached hardwood sulphate, other grades	505-515

The devaluation of the Swedish currency has also caused a major change in the competitiveness of their pulp industry vis-a-vis other major suppliers. In general, Sweden has recently become the lowest cost pulp producer and, as a consequence, Swedish suppliers improved their competitive position not only in western Europe but also in other major world markets.

To summarize, a tight supply/demand balance in 1986 is expected for bleached sulphate pulp in most major world markets. The most promising market for a mill located in Alberta or the B.C. interior appears to be in the mid-west and western regions of the U.S. and, to a lesser degree, in some Asian countries.

Although current prices would not, in economic terms, justify even a moderate expansion of an existing mill, let alone a new mill, more capacity is expected to come on stream as already mentioned in this report. There may be some delays and postponements causing a tight supply during the times of economic expansion, but in the long run, bleached kraft market pulp capacity will keep up with demand throughout the 1980's in spite of the current difficulties outlined in this report.

There do not appear to be any significant market-related constraints with regard to bleached kraft hardwood pulp based on aspen. If there are any constraints on this grade of pulp, they might be production cost related which can only be determined in a detailed feasibility study.

Market Mechanical Pulp

In 1980, when the world production of mechanical pulps totalled 26.7 million tonnes, only about 1.3 million tonnes or about 5% was classified as market pulp and even less was sold in open competition on international markets.

Scandinavia is the largest producer of market mechanical pulps with an output of 830,000 tonnes or approximately 64% of the total world production in 1980. In terms of grade distribution, stone groundwood pulp (SGWP) amounted to 613,000 tonnes or close to 75% of all Scandinavian market mechanical pulp production, whereas market thermomechanical pulp (TMP) totalled approximately 100,000 tonnes in the same year. The remaining part of the total was either refiner mechanical pulp (RMP) or mixed groundwood and thermomechanical pulps.

During the 1970's, the production and consumption of market mechanical pulp varied widely according to the business cycles, but an underlying factor of principle importance was a trend towards higher utilization of bleached mechanical pulp grades. By 1980, bleached mechanical pulp accounted for 40% of the total Scandinavian market mechanical pulp production compared to only 10% in 1970. In our view, the strategy adopted by Scandinavian producers to concentrate on production of bleached grades was necessary if this segment of the industry was to survive. With the exception of a few small plants, each mill in Scandinavia now has facilities to produce bleached grades. Furthermore, the new capacity of about 170,000 tonnes installed recently in Scandinavia (Billeruds in 1981 and SCA in 1982) is fully committed to production of bleached chemi-thermomechanical pulp grades (CTMP).

Canada is the second largest producer of market mechanical pulp, with an installed capacity of approximately 520,000 tonnes in 1982. A new mill, which started up in 1981 in B.C., is in the process of installing bleaching facilities and, in response to changing demand patterns, will produce bleached CTMP starting in 1983.

New Zealand is the only other producer of market mechanical pulp of any significance, although the bulk of the production is captive tonnage mainly for Japan. Winstone Samsung (N.Z.) Ltd. has plans to install a bleaching plant which will allow them to produce bleached CTMP, a much more marketable product than unbleached TMP for which their mill was originally designed. However, it is conceivable that this company might decide to explore the possibility of producing some grades of communication papers in the near future.

In terms of end-use of mechanical market pulp in western Europe, the trend in declining demand for unbleached grades used in newsprint is expected to continue despite a projected increase in newsprint production. A notable exception will be about 140,000 tonnes per annum of TMP expected to be supplied from Canada to the United Kingdom from 1984 on, which although all captive tonnage, will probably be classified as market pulp.

Utilization of bleached mechanical pulp grades in printing and writing papers will likely increase further mainly because of faster growth of coated mechanical papers relative to other grades of printing and writing papers. Potentially, high yield bleached mechanical pulp could also substitute for some bleached hardwood chemical pulps in printing and writing papers but the paper quality requirements, such as high brightness and low brightness reversion, might constrain this substitution considerably.

Scandinavia and some EEC countries, particularly the United Kingdom, tend to prefer to use mechanical pulp over waste papers in some paperboard grades (as middle layers in virgin fibre paperboard or in duplex and solid boards). When compared with waste paper and to some extent with chemical pulps, mechanical pulp improves the bulk and consequently allows for a higher quality, stiffer paperboard and a decrease in the amount of fibre required to produce paperboard of a given thickness. In this context, it should be pointed out that many paperboard grades are being priced according to thickness rather than basis weight. Demand for bleached market mechanical pulp in paperboard is, at present, rather limited mainly due to a high level of integration especially in Scandinavia. However, once the use of bleached mechanical pulp (particularly CTMP) shows a positive effect on the competitive position of integrated paperboard mills, the utilization of this grade of pulp in non-integrated mills in western Europe should increase substantially.

Although the total demand for paper and paperboard products in western Europe declined in 1981, demand for tissue and sanitary products increased by about 3% and, according to our projections, will continue to grow at an average annual growth rate of 3.0% in the period 1982-1986. Demand for high brightness mechanical pulp is expected to increase at the same or a slightly higher rate in higher quality tissue and sanitary products such as diapers and sanitary napkins.

In the softwood deficient regions of Asia, such as Japan, South Korea, Taiwan, India, etc., the high costs of imported softwood pulpwood and the high cost of energy are major reasons why these countries are searching for offshore mechanical pulp supplies on a stable, long term supply basis. In other countries, such as the Peoples' Republic of China, foreign exchange shortages will encourage the import of pulp rather than the higher value alternative of imported paper.

Individual paper makers will make their decisions based on the cost of the options available to them in their search for secured supply. Some paper makers will be constrained by access to wood supplies or the lack of a suitable site for expanded production of pulp or paper. Government policies may also influence or restrict the alternatives they can consider. For example, policy in Taiwan and South Korea is to be self-sufficient in newsprint, whereas Japan has decided to increase imports of the finished product. Foreign exchange constraints in many countries are obviously important factors as well. Consequently, it is not possible to generalize as to how each country or paper company will seek to solve its raw material supply needs.

Japan became the world's leading importer of mechanical pulp during the 1970's. In 1980, the imports of mechanical pulp amounted to 20% of the total paper grade pulp imports compared to only 1% in 1970. In terms of tonnage, Japan imported 375,000 tonnes of mechanical pulp in 1980, of which 85,000 tonnes were high quality bleached pulp. Japanese and, for that matter, all Asian paper makers are currently of the view that TMP is suitable only for newsprint because TMP does not have the smoothness, porosity and opacity characteristics necessary for other grades of cultural papers. On the other hand, stone groundwood pulp, which dominates the mechanical pulp market, is readily accepted in production of groundwood printing and writing papers. Market stone groundwood pulp is, at present, produced almost exclusively from spruce. However, stone groundwood pulp and also pressurized groundwood pulp produced from pinus radiata have strength properties comparable to those of spruce based pulp, as recent trials carried out in Scandinavia have shown. This is encouraging news for potential producers of these grades in Australia and New Zealand.

Further increases in capacities for de-inked pulps, particularly in Japan, will inevitably lead to higher utilization of recycled fibre. De-inked pulps have been competing successfully with mechanical pulps principally in newsprint and this trend is expected to continue. However, there are limiting factors, such as the availability and price of additional recycled fibre, effluent disposal problems from the de-inking process and newsprint quality considerations. Furthermore, to satisfy the publishers' preferences for lower basis weight newsprint and printing paper, more mechanical pulp will be required to maintain good opacity and printability characteristics.

As recently as three years ago, a general consensus in Japan was that de-inked pulp could not be used in any significant quantities for printing and writing papers. Due to improved technology, Japanese paper makers now accept the fact that up to 50% of the mechanical pulp proportion in groundwood printing papers could be replaced by de-inked pulp and, in fact, most of them are firmly committed to expanding their de-inked pulp capacities to achieve that goal.

Notwithstanding the above, it is our view that Japan will offer very good long term opportunities for market mechanical pulp. In our opinion, domestic production of groundwood pulp will not increase due to excessive production costs and no new TMP capacity will be installed in the forseeable future mainly because of high power costs. It is conceivable that, by 1986, demand for market mechanical pulps in Japan will increase by about 300,000 tonnes over the 1980 level. This increase is in addition to the current volume of captive tonnage which Japanese producers import from existing joint ventures in New Zealand and Canada. Aside from Japan, South Korea and Taiwan are expected to increase their imports of mechanical pulp by approximately 60,000 tonnes by 1986.

Because of the location, a mill situated in Alberta or the B.C. interior would seek markets mainly in the U.S., particularly in the tissue and household products segment of the industry. Although the trend in integration of pulp and paper operations in the U.S. is expected to continue throughout the 1980's, the tissue and household segment will remain largely non-integrated. This is a field where transportation, marketing and distribution costs of finished products are more important factors than producing pulp on the same location. In addition, tissue and household products, as well as some specialty papers, usually require blends of different pulps and, in some instances, of waste paper. Consequently, this segment would provide a better opportunity for bleached mechanical market pulp to penetrate the U.S. market than bulk commodities, such as some grades of printing and writing paper and bleached board production, segments which are becoming more and more integrated. It should be noted, for example, that eleven new machines for printing and writing paper, with total capacity 1.08 million tonnes, were installed in the U.S. in 1976-1980 and all of this new capacity is fully integrated with pulp production. Over the same period of time, 36 printing and writing paper machines, with a total capacity of 554,000 tonnes, were permanently shut down, or which 220,000 tonnes was in non-integrated mills. Continuation of this trend in the future will have a negative effect on demand for all grades of bleached market pulps and could potentially hinder the attempt to place substantial quantities of bleached market mechanical pulp on U.S. markets.

The actual size of the U.S. market for bleached mechanical pulp can only be determined in a detailed end-use market study which is beyond the scope of this project. The suitability of aspen for bleached mechanical pulp has been established in both the laboratory and in commercial production. According to the technical report shown in Appendix 2 of this study, aspen is a preferred hardwood species for bleached mechanical pulp. However, the quality of wood resource found in Alberta and the B.C. interior might be a major factor in determining techno-economic feasibility of potential mechanical market pulp production in these regions.

PAPER AND PAPERBOARD - WORLD OVERVIEW

General

Trends in consumption, production and world trade of paper and paperboard, as well as new capacity requirements for total paper and paperboard products by major world regions, are examined in this section.

Consumption Trends

Historic and projected world consumption of paper and paperboard is shown in Table 21.

TABLE 21 HISTORIC AND PROJECTED WORLD CONSUMPTION OF PAPER AND PAPERBOARD

	Consumption (million tonnes)
1960	73.3
1970	125.7
1980	169.5
1985	194.2
1990	221.6
1995	248.4

	Increment (million tonnes)
1960-70	52.4
1970-80	43.8
1980-90	52.1
1980-85	24.7
1985-90	27.4
1990-95	26.8
1980-95	78.9

	Average Annual Growth Rate (%)
1960-70	5.5
1970-80	3.0
1980-90	2.7
1980-85	2.8
1985-90	2.7
1990-95	2.3
1980-95	2.6

Source: SRI, 1982

Note: Historic data based on three year averages, e.g., 1980 is the average of 1979 - 1981.

World consumption of paper and paperboard increased from 73 million tonnes in 1960 to 170 million tonnes in 1980. A noticeable decline in the growth rate was evidenced over the latter part of this period. During the 1960's, world consumption increased at an average annual rate of 5.5%. However, growth over the period 1970-1980 declined to 3.0% due to a combination of factors emanating from a marked worldwide slowdown in economic growth.

The SRI projections suggest that world paper and paperboard consumption will total 248 million tonnes in 1995, reflecting an average annual growth rate of 2.6% in the period 1980-1995. It should be stressed that the SRI projections, as well as any other projections presented in this report, are trend projections which do not attempt to allow for short term cyclical fluctuations in the economy.

Paper and paperboard demand forecasts from published sources, as well as projections prepared by Sandwell in 1982, are shown in Table 22.

TABLE 22 WORLD PAPER AND PAPERBOARD DEMAND PROJECTIONS

(million tonnes)

	Organization	1985	1990	1995
1.	FAO/IWP, 1977	216.2	255.7	-
2.	Stanford Research Institute, 1979	205.9	236.3	267.5
3.	Predicasts, 1980	-	-	314.6
4.	Stanford Research Institute, 1981	195.9	225.8	255.1
5.	Stanford Research Institute, 1982	194.2	221.6	248.4
6.	Jaako Poyry International Ltd., 1982	201.9	237.0	276.2
7.	Sandwell, 1982	193.0	223.0	255.0

As the above table indicates, Sandwell's, as well as the latest SRI projections, are more conservative than those from other primary sources. However, in view of demand constraining factors such as a prolonged world recession of late, a slow-down in the world's population growth, continued threat from plastic materials for some grades of paper and paperboard, trends towards lower basis weight in most grades, potential threats from electronic media on consumption of communication papers, etc., the aforementioned forecasts might be more realistic.

Projections of paper and paperboard consumption by major world region are shown in Table 23.

TABLE 23 APPARENT CONSUMPTION OF PAPER AND PAPERBOARD BY MAJOR WORLD REGION

	Consumption		Increase	Average Annual Growth Rate
	1980	1995	1980-95	1980-95
	(thousand tonnes)		(thousand tonnes)	(%)
North America	65,543	87,216	21,673	1.9
Western Europe	42,393	56,771	14,378	2.0
Eastern Europe	5,742	9,142	3,400	3.1
U.S.S.R.	8,403	15,244	6,841	4.0
Latin America	9,035	16,141	7,106	3.9
Africa	2,524	4,265	1,741	3.6
Asia	33,649	56,065	22,416	3.5
Japan	17,968	28,530	10,562	3.1
Other	15,681	27,535	11,854	3.8
Oceania	2,403	3,597	1,194	2.7

Source: SRI, 1982

In 1980, nearly 40% of world consumption of paper and paperboard was in North America, 25% in western Europe, and 10% in Japan. Other regions of the world accounted for the remaining 25%. According to SRI projections, the 75% share of total consumption held by western Europe, North America and Japan in 1980 is expected to drop to 69% by 1995.

Paper and paperboard consumption in Asia is expected to increase by 22.4 million tonnes in the period 1980-1995. This is the largest increase of all major regions.

Latin America and the U.S.S.R. are projected to experience the highest annual average growth rate of paper and paperboard consumption over the same period of time.

Production Trends

The SRI projections of paper and paperboard productions by major world region are shown in the following Table 24.

TABLE 24 PAPER AND PAPERBOARD PRODUCTION BY MAJOR WORLD REGION

	Production		Increase	Average Annual Growth Rate
	1980	1995	1980-95	1980-95
	(thousand tonnes)		(thousand tonnes)	(%)
North America	70,945	95,374	24,429	2.0
Western Europe	44,652	58,282	13,630	1.8
Eastern Europe	5,300	8,235	2,935	3.0
U.S.S.R.	8,729	16,003	7,274	4.1
Latin America	7,121	14,672	7,551	4.9
Africa	1,571	3,269	1,698	5.0
Asia	30,304	49,712	19,408	3.4
Japan	17,965	26,799	8,834	2.7
Other	12,339	22,913	10,574	4.2
Oceania	2,105	3,959	1,854	4.3
Total	170,769	249,506	78,737	2.6

Source: SRI, 1982.

The concentration of paper and paperboard production in the industrialized countries of the northern hemisphere is expected to decline gradually in the future. In 1960, the share of world production of paper and paperboard held by North America, western Europe and Japan totalled 85%. By 1980, this share had dropped to 78% and by 1995 is expected to decline to 72%.

Latin America and Africa (especially South Africa) are expected to achieve the highest average annual growth rates during the period 1980-1995 in paper and paperboard production.

International Trade

Historic and projected net trade in paper and paperboard by major world region is shown in Table 25.

TABLE 25 NET TRADE IN PAPER AND PAPERBOARD BY MAJOR WORLD REGION

(thousand tonnes)

Region	1970	1980	1995
North America	- 3,888	- 5,402	- 8,158
Canada	- 7,369	- 8,662	- 10,407
U.S.	3,481	3,260	2,249
Western Europe	- 604	- 2,259	- 1,511
EEC	6,080	8,214	10,872
Scandinavia	- 6,928	- 10,102	- 11,879
Other	244	- 371	- 504
Eastern Europe	562	442	907
U.S.S.R.	- 231	- 326	- 759
Latin America	1,725	1,914	1,469
Africa	804	953	996
Asia	1,230	3,345	6,353
Japan	- 413	3	1,731
Other	1,643	3,342	4,622
Oceania	344	256	- 362

Source: SRI, 1982.

Note: - Denotes net exports.

Canada and the Scandinavian countries are the two major paper and paperboard exporting regions of the world. SRI estimates indicate that net exports of paper and paperboard from these regions will increase from 18.8 million tonnes in 1980 to 22.3 million tonnes by 1995. Of particular interest is the fact that, during the period 1970-1995, Oceania and other western Europe will have changed from net importing to net exporting regions. Conversely, Japan is expected to increase net imports by 1.7 million tonnes between 1980 and 1995.

The U.S. will remain a net importer of paper and paperboard but will improve its trade balance by 1.0 milion tons in the period 1980-1995.

The EEC has the largest paper and paperboard deficit in the world. Net imports of paper and paperboard in the EEC are estimated to increase from 8.2 million tonnes in 1980 to 10.9 million tonnes by 1995. The trade position in Other Asia is of interest particularly to Canadian suppliers. Net imports of paper and paperboard in this region are expected to increase by 1.3 million tonnes in the period 1980-1995.

Capacity Requirements

World paper and paperboard capacity estimates for 1980 and 1985 as reported in the FAO capacity survey, and projections for future capacity requirements by major world regions, are presented in Table 26.

TABLE 26

WORLD PAPER AND PAPERBOARD CAPACITY

	Capacity 1980 (million tonnes)	Capacity 1985 (million tonnes)	Net Increase 1980-85 (million tonnes)	Average Annual Growth Rate 1980-85 (%)	Capacity 1990 (million tonnes)	Net Increase 1985-90 (%)	Average Annual Growth Rate 1985-90 (%)	Average Annual Growth Rate 1980-90 (%)
United States	62.5	68.6	6.1	1.9	76.5	7.9	2.2	2.0
Canada	14.7	17.2	2.5	3.2	18.0	0.8	0.9	2.1
North America	77.2	85.8	8.6	2.1	94.5	8.7	2.0	2.0
Western Europe	51.8	57.8	6.0	2.2	62.5	4.7	1.6	1.9
Eastern Europe*	18.1	20.8	2.7	2.8	24.5	3.7	3.3	3.1
Latin America	9.3	12.4	3.1	5.9	15.5	3.1	4.6	5.2
Africa	1.9	3.0	1.1	9.6	3.7	0.7	4.3	6.9
Japan	21.7	24.4	2.7	2.4	27.7	3.3	2.6	2.5
Other Asia**	15.6	18.5	2.9	3.5	23.5	5.0	4.9	4.2
Oceania	2.4	2.7	0.3	2.4	3.7	1.0	6.5	4.4
World	198.0	225.4	27.4	2.6	255.6	30.2	2.5	2.6

*Including U.S.S.R.

**Including Peoples' Republic of China, Taiwan, Centrally Planned Economies of Asia.

Source: FAO, 1980 and 1985.
Sandwell, 1990

World paper and paperboard capacity totalled 198.0 million tonnes in 1980. Slightly over three quarters of the capacity was located in North America, western Europe and Japan. Paper and paperboard capacity throughout the world is expected to increase to 225 million tonnes by 1985, an increase of 27 million tonnes over 1980. This increase in capacity represents an average annual growth rate of 2.6%.

According to FAO, paper and paperboard capacity in Africa, Latin America and Asia (excluding Japan) is expected to increase at a higher annual average growth rate than in other regions in the period 1980-1985. It should be noted, however, that in past FAO capacity surveys, the figures for the aforementioned regions have consistently been overestimated due to the fact that a number of announced projects have been delayed and, in some instances, abandoned for reasons ranging from high costs to political instability.

Sandwell's forecast of paper and paperboard capacity for 1990 is based on projections of future world consumption, production, expected operating ratios by major regions or countries, and current public and proprietory information.

The results of Sandwell's capacity forecasts can be summarized as follows:

- The world capacity for paper and paperboard is expected to increase from 198 million tonnes in 1980 to about 255 million tonnes in 1990, reflecting a net increase of 57 million tonnes or an annual average growth rate of 2.6%.
- In 1990, the world paper and paperboard industry is projected to operate at an average operating rate of 87%. On a regional basis, the expected operating ratio's differ considerably from as low as 76% in Latin America and 78% in Asia (other than Japan), to as high as 93% in North America. The remaining regions shown in Table 6 are expected to operate in the 84 - 88% range.
- Although the developed world regions such as western Europe, North America and Japan will experience low growth rates (i.e. 1.9, 2.0 and 2.5% respectively), the net capacity increase in terms of tonnage of these three regions combined represents 60% of the total increment in the 1980's.
- Total paper and paperboard capacity in other major regions shown in Table 6 is expected to increase at higher than the world average annual growth rate of 2.6%. Some of the fastest growing regions are expected to be Africa, Latin America, Oceania and Asia (excluding Japan).
- Of particular interest are net capacity increments forecast for Asia (excluding Japan), i.e. 7.9 million tonnes, and for Latin America (6.2 million tonnes) and to a lesser degree Africa and Oceania with the total net increment of 3.1 million tonnes in the period 1980-1990.
- A net capacity increase of 6.4 million tonnes forecast for U.S.S.R. and eastern Europe is indeed the least reliable of all regional projections due to insufficient information.
- Regardless of potential developments in other parts of the world, North America will remain the region with the highest absolute capacity increase of approximately 17 million tonnes over the period 1980-1990.
- Paper and paperboard capacity in Canada is projected to increase at an annual average rate of 2.1% in the 1980's. However, the major increase will occur in the period 1980-1986, after which the capacity growth rate will decrease considerably.

NEWSPRINT

General

An assessment of potential markets for newsprint production in western Canadian regions, particulary in Alberta and the B.C. interior, is presented in this section. The discussion encompasses newsprint demand and supply trends for the world, the U.S. and Canada.

There is considerable confusion related to uncoated groundwood communication paper statistics as to the definition of what is considered newsprint and what is not. Uncoated groundwood communication papers are produced primarily from mechanical pulp. These papers are divided by the CPPA into two major categories, "standard newsprint" and "groundwood printing and specialties". In Canada, standard newsprint is defined to include all paper produced largely from mechanical pulp, used mainly in the printing of newspapers and weighing not less than 39.9 gsm or more than 56.9 gsm. The definition of newsprint in the U.S. is quite similar, but includes paper weighing not less than 46.4 gsm or more than 56.9 gsm.

All other uncoated groundwood communications papers containing 50% or more mechanical pulp according to the Canadian definition, or 10% or more mechanical pulp according to the U.S. definition, are classified as "groundwood printing and specialties", "uncoated groundwood" or "groundwood specialties".

Uncoated groundwood printing and specialty papers generally have superior finish, strength and brightness characteristics compared to standard newsprint. A large proportion of this product grouping is comprised of a rotogravure type of printing paper used in catalogues, directories, advertising circulars and supplements. Uncoated groundwood printing and specialty papers are also used by magazine, book and periodical publishers, commercial printers and business form convertors. As markets for uncoated printing and specialty papers, which normally sell at a premium to standard newsprint, are increasing at a fairly rapid rate, many Canadian producers are converting their older newsprint machines to produce these grades.

In the past, statistical problems arising from the definitions of uncoated groundwood communications papers developed primarily as a result of U.S. duties imposed on all groundwood grades with the exception of newsprint. Canadian producers attempted to classify as much of their uncoated groundwood sales as possible under the duty free newsprint classification. Consequently, upgraded forms of newsprint such as uncoated groundwood printing and specialities which have been sold for uses other than the printing of newspapers have, on occasion in the past, been recorded in Canadian statistics under the standard newsprint classification. As a result, Canadian export statistics and U.S. import statistics in many cases do not match. For instance, in 1979, the CPPA indicated that groundwood specialty exports to the U.S. totalled 450,000 tonnes while the API in the U.S. indicated that groundwood specialty paper imports from Canada totalled 560,000 tonnes. Although the tariff on uncoated groundwood papers was discontinued in January 1980, it is believed that newsprint statistics still may include some groundwood and printing specialty grades primarily used by commercial printers for end-uses such as newspaper inserts.

Consumption Trends

Newsprint is the most widely used communications paper in the world. Historic and projected world consumption patterns of newsprint are shown in Table 27.

World newsprint consumption increased from 13.8 million tonnes in 1960 to 26.0 million in 1980, an increase of 12.2 million tonnes. During the 1960's, newsprint consumption increased at an average annual rate of 3.4% but the growth rate fell to 3.0% during the 1970's primarily due to the decline in overall economic growth in the major industrialized countries.

Current economic uncertainties add markedly to the normal forecasting problems, while future consumption of newsprint is difficult to project as demand tends to fluctuate in line with increases and decreases in real GNP. Other factors that must be considered in forecasting future demand for newsprint include newsprint conservation trends, the impact of competing media on newspaper advertising, the increasing use of inserts and basic readership changes. Nevertheless, demand projections which have been developed for this study as shown in Table 27, are considered to be reasonable estimates.

World newsprint consumption has been projected to increase from 26.0 million tonnes in 1980 to 37.0 million in 1995, an increase of 11.0 million tonnes. This increase represents an average annual growth rate of 2.4%, slightly less than that experienced during the 1970's.

For comparison, a summary of demand torecasts developed by several recognized agencies is presented in Table 28.

TABLE 27

HISTORICAL AND PROJECTED WORLD CONSUMPTION OF NEWSPRINT

	Consumption (thousand tonnes)
1960	13,802
1970	19,356
1980	26,000
1985	29,000
1990	33,000
1995	37,000

	Increments (thousand tonnes)
1960-70	5,554
1970-80	6,644
1980-90	7,000
1980-95	11,000

	Average Annual Growth Rates (%)
1960-70	3.4
1970-80	3.0
1980-90	2.4
1980-95	2.4

Source: Historic - FAO, Projections - Sandwell.

Note: Historic data based on three-year averages, e.g. 1960 is the average of 1959 - 1961.

TABLE 28 WORLD NEWSPRINT DEMAND PROJECTIONS

(million tonnes)

Source	1985	1990	1995
1. FAO/IWP, 1977	29.3	32.9	-
2. Stanford Research Institute, 1981	29.0	33.5	37.3
3. Predicasts, 1980	-	-	43.3
4. Sandwell, 1982	29.0	33.0	37.2
5. Stanford Research Institute, 1982	29.2	33.0	36.5

SRI projections of newsprint consumption by major world region published in 1982 are shown in Table 29.

TABLE 29 HISTORIC AND PROJECTED CONSUMPTION OF NEWSPRINT BY MAJOR WORLD REGION

Region	Consumption 1980 (thousand tonnes)	Consumption 1995 (thousand tonnes)	Increase 1980-95 (thousand tonnes)	Average Annual Growth Rates 1980-95 (%)
North America	11,312	14,866	3,554	1.8
Western Europe	5,757	7,101	1,344	1.4
EEC	4,621	5,534	913	1.2
Other	1,136	1,567	431	2.2
Eastern Europe & U.S.S.R.	1,614	2,466	852	2.9
Latin America	1,198	2,256	1,058	4.3
Africa	357	626	269	3.8
Asia	5,113	8,332	3,219	3.3
Japan	2,704	4,057	1,353	2.7
Other	2,409	4,275	1,866	3.9
Oceania	607	876	269	2.5

Source: SRI, 1982

According to SRI, the major developed industrial economies comprising North America, western Europe and Japan will account for slightly over 71% of the world consumption of newsprint in 1995, compared to 76% in 1980. The average annual growth rates in newsprint consumption in western Europe and North America are projected to be below the world average. The fastest growing regions in terms of newsprint consumption are expected to be Latin America, Asia (excluding Japan) and Africa.

The U.S. is the world's largest consumer of newsprint and constitutes Canada's major market. At the turn of the 1980's, newsprint consumption in the U.S. totaled 10.2 million tonnes, which represented slightly over 40% of world newsprint consumption.

in 1980, daily newspapers accounted for 77% of newsprint consumption within the U.S., compared to 87% in 1959. Demand for newsprint for end-uses other than daily newspapers is rapidly increasing. These end-uses include pre-printed advertising inserts and weeklies, as well as a variety of end-uses which substitute for more expensive grades of printing paper. The number of advertising inserts in the U.S. increased from 8 billion copies in 1970 to 27 billion in 1979. According to large retailers, inserts are lower in cost and more flexible in comparison to regular run-of-the-press newspaper advertising.

The total number of daily newspapers in the U.S., as well as their total circulation, has not changed appreciably over the past decade. In 1980, daily newspapers were published in 1,560 U.S. cities, with two or more dailies published in 172 of the cities. Approximately 85% of the daily newspapers have a circulation of 50,000 and under. The twenty largest newspaper companies account for close to 50% of the circulation of dailies, while the twenty largest newspapers account for 22%.

Regional shifts in U.S. daily newspaper circulation over the past decade are shown in Table 30.

TABLE 30

REGIONAL CHANGES IN THE
CIRCULATION OF U.S. DAILY NEWSPAPERS, 1969-1979

	Circulation 1969 (thousand)	Circulation 1979 (thousand)	Change (thousand)	Percent Change
Northeast	16,893	15,228	(1,665)	(9.9)
Mid-west	17,875	17,504	(371)	(2.1)
South	16,164	17,370	1,206	7.5
West	9,645	10,737	1,092	11.3
Total U.S.	60,577	60,839	262	0.4

Source: ANPA

The largest absolute increase in daily circulation over the 1970's occurred in the south with an increase of 1.2 million. In the same period, circulation in the west increased by 1.1 million. These increases were countered by a substantial decrease in daily circulation in the northeast and mid-west totalling 2.0 million. In general, circulation decreased in large metropolitan regions (primarily due to city core deterioration) and tended to increase in towns and cities of less than 100,000 population.

Although the total circulation of the U.S. dailies has been static over the past decade, the average size of the daily newspaper, and hence the amount of newsprint utilized per copy, has risen significantly. The annual newsprint consumption per daily newspaper circulation unit increased from 99 kilograms in 1964 to about 130 kilograms in 1980. A reduction in the trend to larger newspapers is expected in the future in line with slower growth in consumer spending and advertising.

Historic and projected consumption of newsprint in the U.S. is shown in Table 31. More detailed historical data are included in Appendix 3, Table 132. In recent years, the basic weight of newsprint has declined from approximately 52.9 gsm prior to 1974 to 48.8 gsm at present. As a result, unadjusted tonnage figures tend to understate the actual growth in newsprint usage. In order to examine trends in newsprint usage, U.S. consumption data have been adjusted to conform to 48.8 gsm. No adjustments have been made in projected tonnage estimates for future changes in basis weight.

Newsprint consumption in the U.S. increased at a fairly steady rate until the mid-1970's when a recession, rising newsprint prices and newsprint shortages prompted publishers to adopt significant conservation measures such as reducing the space allocations for news items and decreasing promotion expenditures. With the return of economic growth during the last half of the 1970's, newsprint consumption rebounded and outpaced the nation's real economic growth rate.

Consumption of newsprint in the U.S. increased from 6.2 million tonnes in 1960 to 10.2 million in 1980. Over this period, the average annual growth in consumption dropped from 3.0% during the 1960's to 2.0% in the 1970's.

TABLE 31 UNITED STATES
HISTORIC AND PROJECTED CONSUMPTION OF NEWSPRINT

	Consumption (thousand tonnes)
1960	6,225
1970	8,348
1980	10,163
1985	11,300
1990	12,600
1995	13,800

	Increments (thousand tonnes)
1960-70	2,123
1970-80	1,815
1980-95	3,637

	Average Annual Growth Rates (%)
1960-70	3.0
1970-80	2.0
1980-95	2.1

Source: Historic, ANPA, API; Projections, Sandwell.

Note: Historic data are based on three-year averages, e.g. 1960 is the average of 1959-61.

In our view, consumption of newsprint in the U.S. will increase at an annual average growth rate of about 2.1% in the period 1980-1995. This projection, and those of several internationally recognized organizations, are summarized in Table 32.

TABLE 32 UNITED STATES NEWSPRINT DEMAND PROJECTIONS

(thousand tonnes)

Source	1985	1990	1995
1. FAO/IWP, 1977	10,976	11,597	-
2. Stanford Research Institute, 1981	11,300	12,800	13,500
3. Predicast, 1980	11,700	13,200	14,500
4. ANPA/Udell, 1981	11,340	-	-
5. Sandwell, 1981	11,300	12,600	13,800
6. Stanford Research Institute, 1982	11,300	12,500	13,500

Consumption of newsprint in the U.S. by major region is shown in Table 33. In 1980, the northeast accounted for 24% of the nation's newsprint consumption, the mid-west 25%, the south 30% and the west 22%. The share of newsprint consumption held by the northeast and mid-west regions declined during the 1970's. The fastest growing regions in the U.S., in terms of newsprint consumption, are the south and west which jointly increased their share of total consumption from 44% in 1970 to 51% in 1980.

TABLE 33

UNITED STATES
HISTORIC AND PROJECTED
NEWSPRINT CONSUMPTION BY MAJOR REGION AND SUPPLIER

Consumption	Increase/ (Decrease)				Regional Share of Total		Average Annual Growth Rates				
	1970	1980	1985	1990	1970-1980	1980-1990	1970	1980	1990	1970-1980	1980-1990
		(thousand tonnes)			(thousand tonnes)			(percent)		(percent)	
Northeast	2,416	2,426	2,510	2,670	10	244	29.2	23.9	21.2	0.1	1.0
Supplied by:											
Canada	1,812	2,017	2,080	2,210	205	193					
Other	604	409	430	460	(195)	51					
Midwest	2,200	2,517	2,620	2,900	317	383	26.6	24.8	23.0	1.4	1.4
Supplied by:											
Canada	1,928	2,128	2,220	2,470	200	342					
Other	272	389	400	430	117	41					
South	2,151	3,004	3,490	3,930	853	926	26.0	29.6	31.2	3.4	2.7
Supplied by:											
Canada	757	882	850	800	125	(82)					
Other	1,394	2,122	2,640	3,130	728	1,008					
West	1,506	2,203	2,680	3,100	697	897	18.2	21.7	24.6	3.9	3.5
Supplied by:											
Canada	756	1,091	1,220	1,580	335	489					
Other	750	1,112	1,460	1,520	362	408					
Total U.S.	8,273	10,150	11,300	12,600	1,877	2,450	100.0	100.0	100.0	2.1	2.2
Supplied by:											
Canada	5,253	6,118	6,370	7,060	865	942					
Other	3,020	4,032	4,930	5,540	1,012	1,508					

Source: Historic, ANPA, API, CPPA; Projections, Sandwell

Note: Historic data refer to a single year and not a three year average.

Analysis indicates that newsprint consumption in the U.S. will reach 13.8 million tonnes by 1995, 3.6 million tonnes greater than 1980. On a regional basis, newsprint consumption in the northeast region of the U.S. is expected to total 2.8 million tonnes in 1995, an increase of 0.4 million tonnes over 1980. In the mid-west, newsprint consumption is forecast at 3.1 million tonnes in 1995, an increase of 0.6 million tonnes. Newsprint consumption in the south is estimated to total 4.4 million tonnes in 1995, a substantial increase of 1.3 million tonnes. Another large increase is also expected in the west where newsprint consumption is expected to total 3.5 million tonnes in 1995, an increase of 1.3 million tonnes over 1980.

Canada is the major supplier to the U.S. newsprint market. As shown in Table 33 and Appendix 3, Table 133, Canadian newsprint shipments to the U.S. in 1980 totalled 6.1 million tonnes which represented 60% of the nation's newsprint consumption in that year. On a regional basis, Canada supplied 83% of the newsprint requirements in the northeast region, 85% of the mid-west, 29% of the south and 50% of the west.

Newsprint shipments from Canada to the U.S. have been estimated to reach 7.1 million tonnes in 1990, an increase of 0.9 million tonnes over 1980. The increase is expected to be distributed as follows:

TABLE 34 REGIONAL DISTRIBUTION OF PROJECTED INCREMENT OF CANADIAN SHIPMENTS OF NEWSPRINT TO THE UNITED STATES, 1980 TO 1990

(tonnes)

Northeast	193,000
Mid-west	342,000
South	(82,000)
West	489,000
	942,000

Source: Sandwell

As in the U.S., daily newspapers are the major consumers of newsprint in Canada. The number of daily newspapers in Canada totalled 120 in 1980 compared to 113 in 1971. Over the same period, circulation of daily newspapers increased from 4.8 million to 5.4 million, nearly matching population growth. Canadian newspapers' share of advertising revenue in 1980 was approximately 26% compared to 28% in the U.S.

Trends in the consumption of newsprint in Canada are shown in Table 35. More detailed historical data are included in Appendix 3, Table 134. Data on consumption have been adjusted to reflect recent changes in basis weight.

Consumption of newsprint in Canada increased from 0.4 million tonnes in 1960 to 1.0 million in 1980. The average annual growth in consumption over this period was 4.5%, compared to 2.5% in the U.S.

TABLE 35 CANADA
HISTORIC AND PROJECTED CONSUMPTION OF NEWSPRINT

	Consumption (thousand tonnes)
1960	411
1970	609
1980	997
1985	1,150
1990	1,330
1995	1,500

	Increments (thousand tonnes)
1960-70	198
1970-80	388
1980-95	503

	Average Annual Growth Rates (%)
1960-70	4.0
1970-80	5.1
1980-95	2.8

Source: Historic, CPPA; Projections, Sandwell.

Note: Historic data based on three-year averages, e.g. 1960 is the average of 1959 - 1961.

Newsprint consumption in the Prairie provinces, which are considered to be the most logical markets in Canada for production based on B.C. and Alberta poplar resources, is shown in the Table 36.

TABLE 36

CANADA
NEWSPRINT CONSUMPTION BY PRAIRIE PROVINCE

(thousand tonnes)

	Consumption			Increase	Average Annual Growth Rate
	1970	1975	1980	1970-80	1970-80 (%)
Alberta	38.4	56.9	101.9	63.5	10.3
Saskatchewan	13.0	16.8	23.6	10.6	6.1
Manitoba	35.0	37.0	42.7	7.7	2.0
Total Prairie Provinces	86.4	110.7	168.2	81.8	6.9

Source: CPPA

Note: Data based on 3 year averages, e.g. 1970 is the average of 1969 - 1971.

Newsprint consumption in the Prairie provinces reached 168,000 tonnes in 1980. Of the three provinces, Alberta is by far the largest and fastest growing consumer of newsprint. Newsprint consumption in Alberta, which reached 102,000 tonnes in 1980, increased at an average annual rate of 10.2% over the 1970's. In the same period, growth in Saskatchewan and Manitoba was considerably less, with newsprint consumption totalling 43,000 tonnes in Manitoba in 1980 and 24,000 tonnes in Saskatchewan.

The following Table presents several newsprint demand projections for Canada.

TABLE 37

CANADA
NEWSPRINT DEMAND PROJECTIONS

Source	Newsprint Demand 1985	1990 (thousand tonnes)	1995
1. FAO, IWP, 1977	946	1,030	-
2. Stanford Research Institute, 1981	1,099	1,321	1,500
3. Predicasts, 1980	1,225	1,550	1,900
4. Sandwell, 1981	1,150	1,330	1,500
5. Stanford Research Institute, 1982	1,099	1,321	1,366

According to forecasts prepared by Sandwell, newsprint consumption in Canada is projected to increase from 1.0 million tonnes in 1980 to 1.5 million by 1995. This increase represents an average annual growth rate of 2.8% compared to an average annual rate of 2.1% for the U.S. Newsprint consumption in the Prairie provinces, as shown in Table 38, is estimated to total 275,000 tonnes in 1995, an increase of 107,000 tonnes over 1980.

TABLE 38

CANADA

HISTORIC AND PROJECTED NEWSPRINT CONSUMPTION BY MAJOR REGION

Region	Consumption						Increase		Share of Total		
	1970	1975	1980	1985	1990	1995	1970-80	1980-95	1970	1980	1995
			(thousand	tonnes)			(thousand	tonnes)		(percent)	
Prairies	86	111	168	200	230	275	82	107	14.1	16.9	18.3
Other Canada	523	686	829	950	1,100	1,225	306	396	85.9	83.1	81.7
Total	609	797	997	1,150	1,330	1,500	388	503	100.0	100.0	100.0

Source: Historic, CPPA; Projections, Sandwell

Note: Historic data based on three year averages, e.g. 1970 is the average of 1969-71.

Present and Planned Capacity

Historic and projected world newsprint capacities, based on the current FAO survey and Sandwell estimates, are presented in Table 39.

World newsprint capacity in 1980 totalled 28.5 million tonnes which was slightly less than 15% of world paper and paperboard capacity. Newsprint capacity is heavily concentrated in North America which accounts for 48% of the world total. Western Europe accounts for 23%, Japan 10% and the remaining 19% is located in other world regions.

By 1985, world newsprint capacity is estimated to total 35.3 million tonnes, an increase of 6.7 million tonnes over 1980. This rapid rate of expansion over the first half of the 1980's represents an average annual growth rate of 4.3%. In comparison, world demand for newsprint is estimated to increase at an average annual rate of 2.7% over the same period. It is anticipated that the burst of expansion during the early 1980's, which is a response to earlier supply shortages, will tend to have an adverse effect on the industry's operating rate. The implications of the impending over-capacity situation are discussed in a later section.

TABLE 39 WORLD NEWSPRINT CAPACITY

(thousand tonnes)

	Capacity			Increase		Average Annual Growth Rate	
	1975	1980	1985	1975-80	1980-85	1975-80	1980-85
						(percent)	
North America	12,556	13,583	16,400	1,027	2,817	1.6	3.8
Western Europe	5,934	6,603	7,797	669	1,194	2.2	3.4
Japan	2,446	2,866	3,644	420	778	3.2	4.9
Other	4,101	5,497	7,421	1,396	1,924	6.0	6.2
World Total	25,037	28,549	35,262	3,512	6,713	2.7	4.3

Source: FAO, Sandwell

An estimate of newsprint capacity in the U.S. in 1980 and 1985 is presented in Table 40. The estimate is primarily based on the latest API survey which has been updated to conform with recent reports on expansion plans.

TABLE 40 UNITED STATES

ESTIMATED NEWSPRINT CAPACITY BY MAJOR REGION

(thousand tonnes)

	Capacity				Increase 1980-85
	1980		1985		
	(tonnes)	(%)	(tonnes)	(%)	
Northwest	476	10.8	475	8.6	(1)
Mid-west	130	2.9	137	2.5	7
South	2,649	60.2	3,140	57.1	491
West	1,148	26.1	1,748	31.8	600
Total U.S.	4,403	100.0	5,500	100.0	1,097

Source: API, Trade Journals, Sandwell

Newsprint capacity in the U.S. totalled 4.4 million tonnes in 1980. Sixty percent of the nation's newsprint capacity was located in the south, 26% in the west and the remaining 14% in the northeast and mid-west. The newsprint industry in the south is characterized by modern and efficient mills. In the other regions of the U.S., newsprint mills are typically older and often less efficient. A list of U.S. newsprint mills by major region and capacity is included in Appendix 3, Table 135.

By 1985, newsprint capacity in the U.S. is estimated to total 5.5 million tonnes, an increase of 1.1 million tonnes over 1980. Of the estimated capacity increase, the west will account for 55% and the south 45%, with only minor changes expected in other regions.

Major newsprint expansions to 1985, included in the estimate of new capacity in the U.S., are shown in Table 41.

TABLE 41

UNITED STATES
MAJOR NEWSPRINT EXPANSIONS TO 1985

Scheduled Year	Company	Increase in Capacity (thousand tonnes per annum)
1981	Publishers Paper, Newberg, Oregon	190
1981	St. Regis, Houston, Texas	130
1982	North Pacific Paper Co., Longview, Washington	190
1982	Southwest Forest Industries, Snowflake, Arizona	110
1983	Abitibi-Price, Augusta, Georgia	180

Source: Sandwell

The estimate for the U.S. also includes an additional 299,000 tonnes of new capacity for machine improvements and speedups at existing mills. The new capacity estimates do not include the newsprint mill planned by Kruger for Grenada County, Mississippi (200,000 tonnes) or any other proposed but undescribed green field mill in the U.S.

Newsprint capacity in Canada totalled 9.1 million tonnes in 1980 as shown in Table 42.

TABLE 42

CANADA
NEWSPRINT CAPACITY

	Capacities				Increase	Average Annual Growth Rate
	1980		1985		1980-85	
Region	(thousand Tonnes)	(%)	(thousand Tonnes)	(%)	(thousand Tonnes)	(%)
Quebec	4,308	47.2	4,800	44.9	492	2.2
Ontario	1,822	20.0	2,000	18.7	178	1.9
Prairie Provinces*	163	1.8	170	1.6	7	0.8
British Columbia	1,352	14.8	1,920	17.9	568	7.3
Atlantic Provinces	1,485	16.2	1,810	16.9	325	4.0
Total	9,130	100.0	10,700	100.0	1,570	3.2

Source: CPPA, Sandwell.

*Alberta, Manitoba & Saskatchewan.

Nearly 83% of the capacity is located in eastern Canada, 15% in B.C. and slightly less than 2% in the Prairie provinces. The Abitibi-Price mill at Pine Falls, Manitoba is the only newsprint mill currently located in the west. A list of Canadian newsprint mills indicating capacity and location is included in Appendix 3, Table 136.

Newsprint capacity in Canada is estimated to increase from 9.1 million tonnes in 1980 to 10.7 million in 1985. This increase represents an average annual growth in capacity of 3.2%, compared with a rate of 1.1% over the 1970's.

Major projects contributing to the increase in Canadian newsprint capacity over the first half of the 1980's are summarized in Table 43.

TABLE 43

CANADA
MAJOR NEWSPRINT EXPANSIONS TO 1985

Scheduled		Increase in Capacity (thousand tonnes per annum)
Green Field Projects		
1982	Donahue-Normick, Amos, Quebec	140
Machine Additions		
1981	Abitibi-Price, Stephenville, Newfoundland	160
1981	MacMillan Bloedel, Powell River, B.C.	160
1982	Abitibi-Price, Iroquois Falls, Ontario	40 *
1982	B.C. Forest Products, Crofton, B.C.	130
1982	Crown Zellerbach, Elk Falls, B.C.	200
1982	Ontario Paper, Thorold, Ontario	80 *
1983	Kruger Inc., Trois Rivieres, Quebec	100

Source: Sandwell

*Net increase.

In addition to the projects listed in Table 43, the 1985 newsprint capacity estimate for Canada includes 560,000 tonnes of new capacity resulting from machine improvements and speedups at existing plants. Planned projects that are not included in the preceding estimates of annual capacity include the B.C. Forest Products mill at Hurdy, Alberta (130,000 tonnes) and Rexfor/F.F. Soucy mill at Matane, Quebec (150,000 tonnes). These projects are not expected to commence production by 1985. If the proposed B.C. Forest Products project proceeds as planned, production may commence by 1987. The start-up date for the Rexfor/F.F. Soucy project is not decided.

Identification of Potential Markets

Over the years, Canada has been a major exporter of newsprint to the world markets. Table 44 demonstrates the distribution of Canadian shipments and the relative importance of export markets during the 1970's. Market prospects in each of the major markets (i.e., Canada, the U.S. and offshore) for newsprint production originated in the geographical area under investigation are examined in this section.

Domestic consumption of newsprint in Canada is estimated to reach 1.5 million tonnes by 1995, an increase of 503,000 tonnes over 1980. The share of this growing market that could be captured by a new mill in B.C. or Alberta would likely be limited to markets in the Prairie provinces of Alberta, Saskatchewan and Manitoba and perhaps to a few small accounts in the B.C. interior. It is considered unlikely that such a mill could capture substantial accounts in eastern Canada or other parts of B.C., as intense competition could be expected from the large concentration of newsprint mills in those areas.

TABLE 44

DISTRIBUTION OF CANADIAN NEWSPRINT SHIPMENTS

	1970		1975		1980		Increase 1970-80	Annual Average Growth Rate 1970-80
	(thousand tonnes)	(%)	(thousand tonnes)	(%)	1,000 tonnes)	(%)	(thousand tonnes)	(%)
Domestic	609	8.3	797	10.1	997	11.4	388	5.1
United States	5,313	72.5	5,652	71.8	6,184	70.5	871	1.5
Other Markets	1,411	19.2	1,424	18.1	1,590	18.1	179	1.2
Total	7,333	100.0	7,873	100.0	8,771	100.0	1,438	1.8

Source: CPPA

Note: Data based on three year average, e.g. 1970 is average of 1969-71.

Consumption of newsprint in the Prairie provinces in 1980 totalled 168,000 tonnes. Alberta is the largest market on the prairies, accounting for approximately 61% of newsprint consumption in 1980. Manitoba accounted for 25% and the remaining 14% was consumed in Saskatchewan. By 1995, newsprint consumption in the Prairie provinces is expected to total 275,000 tonnes, an increase of 107,000 tonnes over 1980.

In terms of newsprint consumption, only the Winnipeg Free Press can presently be considered as a major account in Manitoba. Logically, all Saskatchewan dailies should be included in the marketing plan. While every effort should be made to capture as large a market share as possible in Alberta, it is probable that most of the projected newsprint demand in the province will be supplied by the proposed B.C. Forest Products newsprint mill located at Hurdy, Alberta which could commence operation by 1987.

At present, there are close to 250 weekly newspapers most of which have an annual newsprint consumption of several hundred tonnes published in the Prairie provinces. These newspapers are usually supplied through local paper merchants. Consequently, paper merchants should also be identified as potential customers.

In summary, the size of the Canadian market, which for a new mill in the west is basically confined to the Prairie provinces, is not large. Furthermore, potential markets in Alberta, the largest and fastest growing province in the Prairie region, will likely be captured by the proposed B.C. Forest Products newsprint mill. In addition, Crown Investment Corporation of Saskatchewan might proceed with their plans to build a newsprint mill in Saskatchewan in the late 1980's or early 1990's. Consequently, only a small share of a new mill's production would be placed in Canadian markets.

The U.S. is by far the largest market for Canadian newsprint. Canadian newsprint producers presently supply 60% of U.S. newsprint requirements. By 1990, Canadian newsprint shipments to U.S. markets are estimated to total 7.1 million tonnes, an increase of 0.9 million tonnes over 1980. This projected increase in exports should present a potential market opportunity for production from a new mill.

A new mill in Alberta or the B.C. interior would not be well located for major newsprint consuming centres in the U.S. Markets in the northeast region of the U.S. will probably continue to be serviced primarily by eastern Canadian newsprint producers. In addition, in terms of newsprint consumption, the northeast region is the slowest growing region in the U.S. Although the U.S. south is a high growth region for newsprint consumption, future demand will likely be supplied by the modern and highly efficient newsprint industry located within the region.

The mid-west and western regions of the U.S. are considered to provide the greatest opportunities for a new mill in B.C. or Alberta. Newsprint consumption in the mid-west is increasing at a modest rate compared to the south. Nevertheless, Canadian newsprint shipments to the mid-west are estimated to reach 2.5 million tonnes by 1990, an increase of 342,000 tonnes over 1980. In addition, newsprint capacity in this region, presently consisting of two mills, is expected to increase only fractionally over the decade. As the mid-west region is located closely to Alberta relative to other regions in the U.S., mill net returns should be reasonably attractive.

Newsprint consumption in the western region of the U.S. is increasing at a fairly substantial rate. Canadian newsprint shipments to this region are expected to total 1.6 million tonnes in 1990, an increase of 489,000 tonnes over 1980, despite a major increase in newsprint capacity in the western region during the early 1980's. However, strong competition in this market can be expected from existing newsprint producers in the western U.S. and western Canada.

Since many publishers, even some with equity participation in newsprint mills, prefer to purchase newsprint from several sources in order to avoid possible disruption in supply, the initial marketing effort should concentrate primarily on major accounts in the market regions previously identified in this report.

Offshore shipments of Canadian newsprint have shown no appreciable growth over the past decade. Offshore shipments totalled 1.5 million tonnes in 1980, of which 41% was to markets in western Europe, primarily the United Kingdom, 34% to Latin America, 17% to Asia and the remaining 8% to Africa and Oceania. Additional data on Canadian overseas newsprint shipments are included in Appendix 3, Table 137.

However, prospects for increasing offshore shipments of Canadian newsprint in the future appear favourable. As the potential supply of Canadian newsprint during the early 1980's will substantially exceed projected demand from North American markets, producers in Canada are expected to concentrate more heavily on capturing additional markets offshore through aggressive sales programs.

In our opinion, western Europe, and the United Kingdom in particular, will continue to provide a substantial offshore market for Canadian newsprint. According to recent forecasts prepared by the SRI, import requirements for the EEC will increase as indicated in Table 45.

TABLE 45

EEC
NEWSPRINT CONSUMPTION, PRODUCTION AND NET IMPORTS

(thousand tonnes)

	1980	1990	1995	Increase 1980-95
Consumption	4,621	5,148	5,534	913
Production	1,765	1,800	2,000	235
Net Imports	2,856	3,348	3,534	678

Source: SRI, 1982

Countries in the EEC with the greatest import requirements in 1995 are, in descending order, the United Kingdom, West Germany, Netherlands and France (see Table 46).

TABLE 46

EEC*
HISTORIC AND PROJECTED
NET IMPORT OF NEWSPRINT

(thousand tonnes)

	1975	1980	1990	1995
France	308	376	335	335
Netherlands	239	280	401	478
West Germany	567	788	850	930
United Kingdom	938	1,022	1,300	1,300
Other	297	390	462	491
Total	2,349	2,856	3,348	3,534

Source: SRI, 1982

*Greece excluded.

However, Canadian suppliers should expect strong competition in the EEC countries, not only from traditional Scandinavian producers (in 1980, 67% of the total Scandinavian newsprint exports was to the EEC), but also from producers in South Africa, Chile, perhaps the U.S.S.R., and Continental Europe.

Latin America is the second largest offshore market for Canadian newsprint. As shown in the following Table, SRI forecasts that net newsprint imports to this region will decline in the future.

TABLE 47

LATIN AMERICA
NEWSPRINT
CONSUMPTION, PRODUCTION, NET IMPORTS

(thousand tonnes)

	1980	1990	1995	Increase (decrease) 1980-95
Consumption	1,198	1,935	2,256	1,058
Production	476	1,212	1,557	1,081
Net Imports	722	723	699	(23)

Source: SRI, 1982.

In our opinion, production in Latin America will not increase at the rapid rate shown in the above table. Moreover, as total production costs in some Latin American newsprint mills are currently substantially higher than the delivered cost of imports from more efficient producers, particularly North American, several newsprint machines in Latin America might be converted to produce higher value communication papers. Consequently, the net import requirements shown in Table 47 may be somewhat understated. Nevertheless, Latin American markets do not show much of a promise in terms of incremental tonnage for Canadian newsprint in the period 1980 - 1995.

Japan will offer increased opportunities for Canadian newsprint producers. Although traditionally self-sufficient in newsprint, Japan's import requirements are expected to increase rapidly. According to SRI forecasts, net import requirements are as follows:

TABLE 48

JAPAN

NEWSPRINT CONSUMPTION

PRODUCTION AND NET IMPORTS

(thousand tonnes)

	1980	1990	1995	Increase 1980-95
Consumption	2,704	3,540	4,057	1,353
Production	2,674	3,219	3,451	777
Net Imports	30	321	606	576

Source: SRI, 1982

Undoubtedly a fairly large proportion of Japan's import requirements will be supplied by joint venture projects with Japanese participation, particularly in New Zealand and North America, which will tend to limit opportunities for independent suppliers.

Other potential markets in Asia include the Peoples' Republic of China for which SRI forecasts net imports of newsprint totalling over 500,000 tonnes by 1995, as opposed to 100,000 tonnes in 1980. However, prospects for this market may be dampened somewhat by a lack of foreign exchange.

Although newsprint capacity in India is expected to increase over the period under review, substantial imports will still be required to cover future demand. Thailand, Malaysia, Singapore and Indonesia could also present market opportunities. Newsprint imports in this group of countries totalled 290,000 tonnes in 1980. Market prospects in this region may be reduced somewhat if one or more newsprint mills planned for Indonesia, Thailand and Philippines were to proceed. However, the majority of projects announced for this region in the past have been abandoned. It is recommended that development plans in this region be reviewed on a continuous basis to determine the status of potential newsprint projects.

In the future, strong competition in markets in the Far East may come from newsprint producers in Oceania. SRI estimates indicate that net exports of newsprint from Oceania may exceed 400,000 tonnes by 1995, an increase of 350,000 tonnes over 1980.

In summary, some countries in western Europe and Asia offer the most promising new market opportunities for Canadian suppliers of newsprint in the period 1980 - 1995. A producer located in Alberta would be at a disadvantage in supplying offshore markets, particularly against Canadian competitors located on tidewater. However, under certain conditions which will be discussed later in this report, a newsprint mill located in Alberta or the B.C. interior could, in fact, allocate a portion of its production for offshore markets.

Price Considerations

Newsprint has shown a much less volatile price history than most of the other pulp and paper products, especially in North American markets. This results from the historic long-term relationships established between a limited number of major pulp producers and publishers. Historic newsprint prices in the U.S. are shown in Table 49.

TABLE 49 NEWSPRINT PRICE HISTORY * 1955-1981

(US$ per tonne)

1955	139
1956	143
1957	147
1958	148
1959	148
1960	148
1961	148
1962	148
1963	148
1964	148
1965	148
1966	151
1967	155
1968	156
1969	162
1970	168
1971	174
1972	181
1973	193
1974	231
1975	287
1976	311
1977	333
1978	348
1979	386
1980	436
1981	482

Source: ANPA, CPPA.

*Annual average contract price for newsprint delivered to New York City. Prices to 1974 are for 52 gsm newsprint; thereafter for 48.8 gsm newsprint.

The price of newsprint delivered to U.S. markets remained fairly static through the period 1955 - 1965 within the narrow range of US$139 to $148 per tonne. Since 1965, prices increased at a modest rate reaching US$193 per tonne in 1973. However, when measured in constant dollars, prices actually declined throughout the entire period 1955 - 1973.

In 1973 - 1974, demand for newsprint rose dramatically and, as a result, prices increased 28% over these two years providing some relief from the cost-price squeeze. In subsequent years, prices have continued to move up rapidly and reached the level of approximately US$500 per tonne in September 1981. The increase was reduced, in part, by a change in basis weight of standard newsprint from 52 gsm (32 pounds per 3000 sq.ft.) to 48.8 gsm (30 pounds) which occurred in the mid-1970's.

The list price of US$500 per tonne prevailed in most U.S. markets until the late fall of 1982, in spite of repeated efforts by Canadian suppliers to increase prices to the range of US$525 to US$540. Due to serious oversupply of newsprint, caused by world-wide recession and also by recent capacity increases, some U.S. producers had, in fact, decreased the price of newsprint to US$468 effective November 1982. It is interesting to note that this is the first such decrease in the U.S. newsprint price since the 1930's.

The price of newsprint delivered to Canadian markets closely follows the price trend in the U.S. Historically, the Canadian price has been slightly lower than the price in the U.S., reflecting the higher cost of delivery to markets in the U.S.

Until the mid-1970's, Canadian producers had not benefited substantially from the relative changes in the U.S. and Canadian exchange rates. However, since 1976, the export sales revenue of Canadian producers on a per tonne basis has increased much faster than revenue from domestic sales, mainly due to the weakness of the Canadian dollar. This is evidenced in Appendix 3, Tables 138 and 139. The differential has gradually widened to the point where some Canadian mills have been obtaining as much as C$120 per tonne more on export sales than on domestic.

In order to decrease this gap, Canadian suppliers increased the price of domestic newsprint to C$540 per tonne at the end of 1981, while the price in U.S. markets remained unchanged at US$500 per tonne. Recent history of Canadian list prices for domestic markets is shown in Table 50. Canadian customers also get the benefit of a reduction as their list price has recently been reduced to C$515 per tonne. In addition, some tonnage is now being offered at C$10 to 20 per tonne less than the list price.

TABLE 50

CANADA

DOMESTIC NEWSPRINT LIST PRICES

(C$ per tonne)

Effective		List Price
January	1980	408
May	1980	440
January	1981	470
August	1981	500
December	1981	540
Nov.-Dec.	1982	515

Source: Sandwell.

Prices shown in Table 50 generally apply to customers on the B.C. coast and in eastern Canada, including Manitoba. In the past, customers in the B.C. interior, Alberta and, to some extent, in Saskatchewan have been charged a premium based mainly on higher delivery costs. The price surcharge, which varies according to distance and means of transportation (truck or rail), amounted to $15 to 20 per tonne in 1981 - 1982. The surcharge will likely disappear in the future, especially if a newsprint mill is built in Alberta or Saskatchewan.

During most of the 1970's, even with significantly higher transportation costs, Canada's offshore newsprint exports have generally been at least as profitable as exports to the U.S. However, during the past two years, the profitability on some offshore tonnage has deteriorated significantly, especially on exports to western Europe.

Unlike market pulp which is priced in U.S. dollars, newsprint is generally quoted in local currencies. As western European currencies have declined in value against the Canadian dollar, the mill nets (the selling price less transportation costs) in Canadian dollars for newsprint exports to western Europe are, for the first time in many years, lower than the mill nets realized from selling into U.S. markets.

A historic price series for standard newsprint (48.8 gsm) delivered to the United Kingdom is shown in Table 51. At the end of January 1983, the price, U.K. pounds 300 per tonne, provided a return of about US$460. By comparison, at the end of 1981, the same price (U.K. pounds 300 per tonne) yielded a return of about US$600 per tonne, mainly due to an exchange clause which protected suppliers against erosion in the value of the pound. The exchange clause mechanism has since been eliminated.

TABLE 51 UNITED KINGDOM
AVERAGE PRICE OF NEWSPRINT IMPORTS (CIF)
(Pounds sterling per tonne)

Year	Quarter	Price	Year	Quarter	Price
1970	1	63.24	1976	1	154.83
	2	64.14		2	186.22
	3	65.03		3	210.77
	4	66.58		4	225.50
1971	1	74.73	1977	1	235.00
	2	79.72		2	235.00
	3	74.06		3	235.00
	4	72.56		4	235.00
1972	1	67.27	1978	1	235.00
	2	67.78		2	235.00
	3	71.94		3	235.00
	4	75.08		4	235.00
1973	1	75.67	1979	1	225.38
	2	75.38		2	251.88
	3	81.19		3	258.21
	4	96.70		4	172.98
1974	1	101.98	1980	1	270.00
	2	108.52		2	270.00
	3	140.61		3	270.00
	4	177.81		4	270.00
1975	1	143.46	1981	1	270.00
	2	152.39		2	270.00
	3	168.10		3	300.00
	4	184.16		4	300.00
			1982	1	300.00
				2	300.00
				3	300.00
				4	300.00

Source: Johnsen, Jorgensen & Wettre Ltd.

In the next 2 - 5 years, market prospects for a newsprint mill located in Alberta or B.C. are not promising due to an impending over-capacity in the North American industry. The imbalance will intensify competition for markets in North America and offshore as capacity will be substantially greater than demand. For the next two years or so, the Canadian newsprint industry is expected to operate at barely 80% of capacity and the

Canadian share of the U.S. markets is projected to decrease by 4% - 6% from 1980 level. In 1985, the Canadian operating rate is estimated by Sandwell to be of the order of 86%, still well below the historic average.

The operating rate of the newsprint industry in the U.S. is not expected to be affected to the same degree as the Canadian rate during the period of imbalance. In the past, newsprint consumers in the U.S. have preferred to purchase their supplies from domestic producers. It is anticipated that this preference will continue to occur in the future and, based on increased capacity, U.S. producers will have the capability to supply a substantial portion of new demand.

Although the situation in the North American newsprint industry is expected to improve by 1985 - 1986, it might take up to the latter part of the 1980's to completely eliminate the imbalance.

Several factors may improve the supply/demand balance in the late 1980's. It is likely that Canadian newsprint producers will do their utmost to avoid a prolonged period of low operating rates. If the fierce price/cost competition continues for another year or two, many more old machines in Canada would become unprofitable and some will be shut down permanently. In addition, several companies such as MacMillan Bloedel, Abitibi, Domtar, Consolidated Bathurst and others may convert more newsprint capacity into groundwood specialty paper grades or other paper grades at a relatively low cost. Furthermore, several Canadian mills could readily switch from newsprint production to other grades of groundwood communication papers without any physical changes in existing equipment. Naturally, the various strategies are also limited by market constraints for these grades of paper.

It is not inconceivable that some newsprint producers in the U.S., especially those located on tidewater, might find exports more profitable than the supply to relatively remote domestic markets, such as some mid-west and western states. This would give a better chance to suppliers located in Central Canada (including Alberta) to supply these markets.

On the negative side, the future supply/demand balance might be further impaired by factors such as a reduction of basis weight in standard newsprint and the impact of electronic media on newsprint consumption. It is possible that, within the next five to ten years, the average basis weight of standard newsprint sold in North American markets will be in the order of 46 gsm. The net impact of such a change would cause a 5% weight reduction, approximately, in North American newsprint consumption.

Long term market prospects, i.e., from 1987 - 1988 on, for a newsprint mill in the area under investigation could be rather promising. Long term forecasts indicate that newsprint consumption will continue to increase at a modest but fairly steady rate of growth. Over the period 1985 - 1995, newsprint consumption throughout the world is forecast to increase by 8 million tonnes and, on the basis of a 90% operating rate, world newsprint capacity would have to be approximately 41 million tonnes in 1995 in order to supply the increased demand. Consequently, over the period of 1985 - 1995, six million tonnes of new capacity will be required, which is equivalent to the annual production of approximately 25 modern newsprint machines each of 160,000 tonnes annual capacity. The actual new capacity requirements might be even higher since the estimate does not include any capacity required to replace obsolete machines which might be shut down during the period.

Potential markets for a newsprint mill located in Alberta or B.C. would likely develop in the U.S., Canada, and to a lesser degree, in related offshore markets. The mid-west and western regions of the U.S. are considered to be the major markets for such a mill. In particular, the mountain regions of the west (e.g., Colorado) should be considered promising markets as they are presently supplied by mills in the U.S. Pacific Northwest, B.C., eastern and the southern U.S., all of which are at a considerable distance from these markets.

The Canadian market for newsprint production from Alberta or the B.C. interior will be relatively small as it is anticipated that sales will be confined to the Prairie provinces.

If the Canadian dollar weakens in relation to major EEC currencies to pre-1981 levels, Canada's competitive position in the EEC countries will improve substantially. On the other hand, Scandinavian producers have already improved their competitive position in these markets due to the recent devaluation of their currencies. All Scandinavian producers will gain free access to EEC markets, i.e., they will no longer be subjected to import quotas by 1984. This, coupled with the possibility of even higher levels of protection for EEC producers in the form of non-tariff barriers, may prevent Canadian suppliers from making significant gains in EEC markets.

In the long run, markets in the Far East may show a greater potential for expanded sales than those in western Europe. Although a similar argument based on exchange rates, specifically in Japan, and protectionist attitudes in the form of non-tariff barriers may apply in most of the countries in the Far East, the competitive position of Canadian producers in these markets should be more favourable than in Europe since Canadian producers, especially those on the west coast, have better access to Far East markets than Scandinavian suppliers.

As an independent source of supply, a mill located in the aspen region of Alberta or B.C. would find it difficult to compete in offshore markets with the coastal mills. In fact, the risk involved in marketing newsprint produced in regions under review even in North American markets, will be considerable. However, there are several methods of reducing or eliminating potential difficulties arising from market-related constraints which could be applied in this case. A potential producer could seek a joint venture in terms of equity participation with either domestic or foreign publishers who would be prepared to buy a substantial quantity of newsprint for their end-use. Alternatively, a joint venture could be arranged with an existing large newsprint producer with its own marketing organization through which the majority of tonnage would be sold, particularly abroad.

In summary, on the basis of a preliminary analysis, we consider the short-term market prospects for a newsprint mill located in Alberta or B.C. to be unfavourable because of the imbalance in supply and demand. Long term market prospects from the late 1980's onward are more promising, especially if a joint venture is undertaken. However, an in-depth study of all findings in this preliminary assessment, particularly those related to North American regional markets, should be undertaken prior to decisions being taken.

PRINTING AND WRITING PAPERS

General

Paper has been, and is expected to be, the most important medium for storing and communicating information. Although the rapid development of electronic media implies a prospect of eventually dampening growth in consumption of printing and writing paper, the trend to date has been as much a partnership as a head-on competition between electronic media and paper.

With the advent of high-speed, multicolor printing presses, as well as the vast proliferation of office copy and duplicating equipment, the printing and writing segment of the paper industry has, in recent years, enjoyed faster growth than any other major segment of the industry. The paper industry has met the challenge, with the result that there are literally dozens of papers each made for specialized end-uses.

The growth of writing papers can be traced directly to the growth of the general economy and the need to transmit and store the vast quantities of information generated by computer technology. Contrary to earlier expectations, the tremendous surge of information processed by computers has increased paper demand, not reduced it. The growth and improvement of office copy machines and word processing equipment has had an extraordinary impact on the use of plain white papers and specially treated papers.

Printing and writing paper grades may be placed within one of four primary classifications. These classify paper grades according to the presence or absence of mechanical pulps and also according to the presence or absence of coatings applied to improve the appearance and surface. The categories are as follows:

- Mechanical papers* - papers made primarily from mechanical pulps.
- Wood-free (or free) papers - papers made from chemical pulps, or papers substantially free of mechanical pulp, i.e., less than 10% mechanical pulp content in the U.S. and, usually, less than 15% in Europe.
- Coated mechanical paper - papers made primarily from mechanical pulps and surface coated with pigments and fillers incorporated in an adhesive binder.
- Coated free paper - paper made from chemical pulps and surface coated with pigments and fillers incorporated in an adhesive binder.

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*Mechanical papers are also known as "groundwood printing and writing papers" or "wood containing papers".

The distinction between the two pulp-furnish classifications, free and mechanical, is becoming blurred and grades are appearing that are described as "slightly wood containing", "near wood-free", and "part-mechanical". The papermaker's objective is to optimize performance and cost. If lower cost mechanical or chemi-mechanical pulp can be used without lessening the appearance or utility of the paper, the papermaker is not constrained by traditional definitions.

Among the world's major consuming regions, there is a substantial variation in the relative consumption of each of the four classifications of printing and writing paper, as shown in Table 52.

TABLE 52

WORLD PRINTING AND WRITING PAPER CONSUMPTION BY GRADE

	Percentage of Total		
	U.S.	Western Europe	Japan
Uncoated wood-free	56.4	35.5	
Uncoated mechanical	13.3	28.3	
Subtotal	69.7	63.8	67.2
Coated free	10.3	14.3	
Coated mechanical	20.0	21.9	
Subtotal	30.3	36.2	32.8
Total	100.0	100.0	100.0

Sources: API, SRI, OECD, JPPA.

The U.S. uses much more uncoated wood-free paper than western Europe, reflecting consumer preferences and lower paper prices in the U.S. Europeans accept a greater proportion of lower cost mechanical papers for printing. These are heavily loaded with clays and smoothed by intensive calendering (supercalendered, or S/C), and they are less costly to produce than wood-free papers.

Data on wood-containing paper consumption in Japan are not available, but there are indications that the Japanese consumption pattern is similar to that in Europe with, perhaps, a slightly greater proportion of uncoated mechanical papers used.

Within the four primary classifications of printing and writing paper, an almost infinite variety of characteristics may be imparted to meet specific end-use requirements. The most important techniques for obtaining special properties are the use of inert fillers, chemicals, and mechanical surface treatments.

Different wood pulps also impart different properties to paper. The most expensive, softwood chemical pulps, are used primarily to provide strength (tear and tensile) and to enhance brightness. The slightly less expensive, bleached hardwood chemical pulps provide the best printing and writing surfaces because of their small fibre size. The least expensive, mechanical pulps are relatively stiff and coarse, and are used in many grades of printing and writing papers to improve bulk and opacity. Different types of wood pulp are often mixed to produce a single type of printing and writing papers.

The species of wood used to produce wood pulp also affects the quality characteristics of paper. For example, Canadian and northern U.S. softwood species, such as spruce, balsam fir, etc., and hardwood species, such as birch, maple, beech and poplar, are generally more highly regarded for papermaking than the southern U.S. softwoods (e.g., pine) and hardwoods (e.g., oak, gums, etc.).

Finally, paper characteristics can also be influenced by the degree of refining and bleaching of wood pulp and by the operating conditions of the paper machine.

Further descriptions of typical grades and standard weights are provided in Appendix 3, Table 140.

Consumption Trends

Historic and projected world consumption of printing and writing paper is shown in Table 53. World consumption increased from 27.3 million tonnes in 1970 to 42.0 million tonnes in 1980, an increase of 14.7 million tonnes. According to the SRI forecast prepared in 1982, world demand for printing and writing papers is expected to reach 63.8 million tonnes in 1995, reflecting an average annual growth rate of 2.8% over the 1980 - 1995 period.

As in the case of newsprint, SRI's demand projections for printing and writing papers are more conservative than those from other public sources shown in Table 54. It is our view that the SRI projections appear to be reasonably realistic in so far that the effects of the current prolonged recession have been taken into account in their long-term forecasts.

TABLE 53 WORLD CONSUMPTION OF PRINTING AND WRITING PAPER

	Consumption (thousand tonnes)
1970	27,330
1980	42,011
1990	55,903
1995	63,796
	Increments (thousand tonnes)
1970-80	14,681
1980-90	13,892
1980-95	21,785
	Average Annual Growth Rates (%)
1970-80	4.4
1980-90	2.9
1980-95	2.8

Source: SRI, 1982.

Note: Historic data based on three year average, e.g., 1970 the average of 1969 - 1971.

TABLE 54 WORLD DEMAND PROJECTIONS FOR PRINTING AND WRITING PAPER

(million tonnes)

Source	1985	1990	1995
1. FAO/IWP, 1977	-	57.8	-
2. Predicast Inc., 1980	-	-	72.7
3. Stanford Research Institute, 1981	48.5	57.5	66.8
4. Stanford Research Institute, 1982	48.0	55.9	63.8
5. Jaakko Poyry International, 1982	51.2	62.1	74.5

Future consumption of printing and writing paper by major world regions is presented in Table 55.

North America and western Europe will continue to be the major consuming regions in spite of a relatively low growth rate in the 1980 - 1995 period. The fastest growing consuming regions are projected to be Latin America, Africa and, to a lesser degree, U.S.S.R. and Asia.

TABLE 55 CONSUMPTION OF PRINTING AND WRITING PAPER BY MAJOR WORLD REGIONS

Regions	Consumption 1980 (thousand tonnes)	Consumption 1995 (thousand tonnes)	Increase 1980-95 (thousand tonnes)	Average Annual Growth Rate 1980-95 (%)
North America	15,617	22,725	7,108	2.5
Western Europe	12,646	17,975	5,329	2.4
Eastern Europe	829	1,257	428	2.8
U.S.S.R.	1,283	2,180	897	3.6
Latin America	1,780	3,737	1,957	5.1
Africa	536	955	419	3.9
Asia	8,886	14,300	5,414	3.2
Oceania	434	667	233	2.9

Source: SRI, 1982.

Of particular interest to this study is the consumption of printing and writing papers in the major developed economies comprising the U.S., Canada, western Europe and Japan, which, in aggregate, account for 77% of the world's total consumption, as shown in Table 56.

TABLE 56 WORLD PRINTING AND WRITING PAPER CONSUMPTION, 1980

Region	Consumption (million tonnes)	Consumption (%)
North America, Western Europe, and Japan	32.3	77
U.S.S.R. and Eastern Europe	2.1	5
Latin America	1.9	5
Africa	0.5	1
Asia, except Japan and China	2.7	6
China	2.2	5
Oceania	0.4	1
Total	42.1	100

Source: FAO, OECD, Trade Publications, SRI.

The remaining important consuming regions of the free world, Latin America, Africa, Asia (excluding Japan and China), and the Middle East, account for 12% of the world's consumption of printing and writing papers. Most of these countries are in the early stages of expanding their economies and industrial bases.

In the publications and advertising area, paper has already suffered from the impact of television, which virtually destroyed general interest magazines. Magazines have been able to recover in recent years with the development of a host of special-interest publications. In addition, substantial growth in paper consumption has been promoted by a proliferation of catalogues and direct mail advertising. There are, nevertheless, threats on the horizon: new electronic information and entertainment media vying for the time consumers now spend reading and, in some cases, substituting directly for the reading matter; and electronic means that substitute directly for catalogues, directories, and mail for disseminating consumer information and advertising.

Table 57 shows the classification and consumption of printing and writing paper by end-use in the U.S.

TABLE 57 U.S. CONSUMPTION OF PRINTING AND WRITING PAPERS BY END-USE

	Consumption 1980	Average Annual Increment 1980-95
	(thousand tonnes)	
Magazine publishers	1,980	21.7
Other periodical publishers	1,117	30.8
Book publishers	819	16.8
Commercial printers	3,696	92.4
Office reprographics	1,476	64.9
Label and wrappers	301	5.3
Envelopes	835	16.9
Business forms	2,030	173.2
Stationery and tablets	347	-1.9
Other converting	559	-1.0
Government	47	1.1
Total	13,207	420.2

Source: SRI.

Note: Excludes thin papers, cotton papers and bristols.

Factors affecting magazine paper consumption are very closely related to the GDP and the resulting advertising budgets. In 1981, magazines enjoyed about an 11% share of all print media advertising dollars, or $3.5 billion. The general level of the economy is doubly important to magazine publishers because, during periods of recession, not only does advertising revenue fall but newstand and subscription sales also suffer.

Rising distribution costs, caused by postal rate increases, have forced publishers to seek means of reducing the impact of those increases. Ten years ago 40 lb. (59 gsm) paper was considered light weight. Today, many publishers are using 34 lb. (50 gsm) paper to reduce distribution costs, and some are going to 32 lb. (47 gsm) paper. Because of strength and opacity requirements, it is doubtful if weights will be reduced significantly below these levels in the near future.

According to SRI, the probable trend in magazine paper consumption in the 1980's is for tonnage to grow more slowly than the 1.3% annual rate experienced in the mid to late 1970's. Growth should be well below GDP, partly attributable to a reduction in average weights. The emphasis in magazine circulation growth will continue to be in the area of special-interest magazines. A resumption in growth is projected after recovery from the current recession.

The outlook for book paper demand in the U.S. is not very promising. Factors, such as limited government funds available, declining school enrollment, shorter press runs of books, extended periods for revision and republishing, etc., will have a negative impact on demand for educational textbooks. Technical and professional books are expected to record growth rates of 2 to 3% annually to 1990, while other books such as trade books (novels, paperbacks, cookbooks), reference books, religious books, etc., are projected to show lower growth rates, i.e., below 2% annually.

There are more than 42,000 commercial printers in the U.S., 31,000 of whom employ only 20, or fewer, people. These are the firms that produce the thousands of annual reports, direct mail advertising pieces, instruction manuals, promotional brochures, etc., that make up the commercial printing industry. Commercial printers consume more printing and writing paper than any of the other end-using groups. In 1980, commercial printers in the U.S. accounted for more than 25% of the U.S. printing and writing paper consumption.

Letterpress, offset lithography, and gravure printing processes are widely used by commercial printers. The letterpress process, however, is fast giving way to offset and gravure, with the fastest growth in web offset. The growth in web, compared to sheet offset printing has increased shipments in roll form and consequently reduced the share of cut-to-size. Furthermore, offset printing requires lint-free papers with relatively low ink absorbency, which causes the printers to use wood-free or coated mechanical papers in place of uncoated mechanical. Sheet-fed offset is still widely used but is not growing as rapidly as web.

Commercial printing materials are used in all sectors of the American economy. Therefore, the single most important factor affecting consumption is the general level of business activity, and commercial printing activity tends to follow the business cycle very closely.

Office reprographic paper is one of the major business-related end-use categories. The trends in growth of copier placements and white-collar employment are expected to continue, but the pace will be somewhat slower.

In the 1980's, reprographic paper consumption is expected to grow an average of 3.8% annually. By the 1990's, the growth in copy paper use will slow. Not only will copier placements slow but, in addition, personal electronic terminals with video screens and high-speed printers will appear in offices, reducing the need for copying archival documents. Paper consumption gains in the 1990's, nevertheless, should be substantial, being approximately equal to the real GDP growth rates.

Business forms, the second major category of business-related paper consumption, include single and multiple copy forms, individual form sets, order books and continuous forms.

Growth in paper consumption for business forms has been extremely rapid, nearly tripling between 1971 and 1980. No other paper product parallels this growth. Forms consumption grew because of the proliferation of high-speed computer systems that produce information and transaction documents including customer billings, data processing, numerical activity reports and text.

Although the 1970's growth trend is not sustainable, consumption of forms paper is expected to increase by about 90% to over 4 million tonnes during the 1980's. Shifts in paper grades used in this market are expected as business systems and computer output equipment change. Trends already noted are slower growth in use of continuous, multiple-part forms and faster growth in lower cost papers for use with smaller computers.

The four remaining printing and writing paper end-use segments account for about 15% of total printing and writing paper consumption. None is expected to grow at above-average rates.

> Label and wrapper - printing has grown very little since 1973. Changing packaging methods, especially shifts to flexible or rigid plastics and direct label printing on product containers, have slowed the use of printed paper and will continue to retard growth. Paper consumption and wrap manufacture in the 1980's are expected to grow at less than 1% annually.
>
> Envelope production - has also slowed. Many computer transactions are printed on forms that eliminate the need for separate mailing envelopes. Envelopes have also suffered loss of market from the greater use of voice communication and other systems. The outlook for envelope paper consumption is for slow growth, less than 2% annually in the 1980's and further slowing in the 1990's, as electronic data and text transmissions increase.
>
> Stationery and tablet - consumption will be flat or declining during the 1980's. The impact of declining educational enrollment is the primary reason for the decline, although office systems changes, especially word processors and personal terminals, will also act to reduce consumption by 1985 and beyond.
>
> Other end-uses - include government purchases of printing and writing paper and the manufacture of table placemats, bank cheques, gummed papers, gift wrap, adding machine tapes, and similar items that do not fit into the categories previously described. This is a very broad category, but one in which paper use is relatively small, about 4% of the total. Paper consumption in this category is not growing for a variety of reasons, including replacement of paper products by plastics and adverse impacts on consumption because of electronic substitution. Although individual opportunities for growth in some of the miscellaneous end-uses exist, these are unlikely to increase significantly the overall consumption of printing and writing papers in this category.

In general, key factors affecting consumption of printing and writing papers in other developed countries, do not differ significantly from those shown for the U.S. However, there are marked differences in the relative effect which individual factors might have on consumption in some countries as will be discussed herewith.

Canada's proximity and economic and cultural similarities to the U.S. have created similar forces for change in the factors influencing printing and writing paper consumption. The following table provides comparisons between the U.S. and Canada for data relevant to printing and writing paper consumption.

TABLE 58 COMPARISON OF CANADIAN AND U.S. CONSUMPTION OF PRINTING AND WRITING PAPER

	Canada %	U.S. %
Real GDP average annual rate of change		
1960-1974	5.4	3.8
1974-1981	2.6	2.8
1981-1990	2.8	2.8
GDP per capita, 1981 U.S. dollars	11,603	12,481
1980 consumption per billion dollars GDP (thousands of tonnes per billion U.S. dollars)	4.57	5.62
Advertising expenditures as a percent of 1980 GDP		
All advertising	1.21	2.12
Print media advertising	0.80	1.09

Source: Starch, INRA, Hooper, OECD, IMF, SRI projections.

Although Canada uses less printing and writing paper and spends proportionally less than the U.S. on advertising, the GDP growth rates from 1974 to 1981 and the projected rates are quite similar, and the GDP per capita values are roughly equal.

Canada's paper consumption will continue to be somewhat lower in terms of tonnage per unit of GDP. The bases for this conclusion are the differences in the nature and size of the two countries' business sectors and their advertising expenditure levels.

Western Europe's consumption of printing and writing papers in the 1970's grew at the rate of 3.9% annually, one-third above the average growth in consumption for all paper and paperboard products in western Europe and slightly above the U.S. growth in printing and writing paper. European economic forecasts suggest moderate growth in GDP during the 1980's, falling to a 2% annual real rate of increase from a level of about 3% in the 1970's. Consumption of printing and writing paper is expected to continue to exceed real GDP increases but to grow more slowly than in the past, averaging 2.5% annual growth during the 1980's.

In comparison to GDP, advertising expenditures in western Europe are less than half those in the U.S., but spending on print media is more nearly equal. Table 59 shows that spending for advertising in Europe for all types of print media is 56% of the U.S. rate, while spending for magazine advertising is of the same magnitude.

TABLE 59 WESTERN EUROPEAN ADVERTISING EXPENDITURES AS A PERCENT OF GDP, 1980

	Total Advertising	Print Media Advertising	Magazine Advertising
EEC	0.95	0.60	0.16
Scandinavia	1.21	0.93	0.14
Other Western Europe	0.93	0.51	0.18
Total Western Europe	0.97	0.61	0.16
United States	2.08	1.09	0.19

Source: Starch, INRA, Hooper.

A major reason for the popularity of print media advertising in western Europe is the restriction placed on commercial TV and radio broadcasting. In the United Kingdom, the national BBC networks offer competition to commercial broadcasting; Finland does not have commercial radio stations; and Sweden, Norway and Denmark have neither commercial radio nor TV stations. In all other European countries, governmental agencies control and severely restrict the advertising content of TV and radio broadcasting. Commercial broadcasting could be expanded, however, and commercial cable or satellite TV could be used extensively. Either action would provide new competition for print media advertising. Cable and satellite transmission are unlikely to be in general use for 5 years or more, precluded by technological and capital constraints. Growth of electronic competition, however, is most likely to reduce print advertising growth by 1990 and beyond.

The grade mix of the four principal grades of printing and writing papers has been changing in western Europe. For example, uncoated mechanical papers have lost their market share to coated mechanical papers. During the 1970's, the market share of uncoated mechanical paper declined from 45% to about 28%. Concurrently, coated mechanical paper increased its share of the total consumption from 9% in 1970 to 22% in 1980. This trend is expected to continue as a greater proportion of magazines and advertising materials are printed on higher print-quality, lower-grammage weight coated mechanical grades.

In the wood-free grades, the share of market for coated and uncoated wood-free papers has been relatively stable over the 1970's. Coated wood-free paper increased its share from 10% in 1970 to about 14% in 1980 and is expected to stablize at the 1980 level for the next 10 years or so. The market share for uncoated wood-free papers remained at approximately 35% of total consumption throughout the 1970's.

In comparison to the U.S., the principal differences in European printing and writing paper consumption are as follows:

- Lower consumption of uncoated wood-free papers.
- Greater consumption of uncoated mechanical papers.
- Greater use of fillers in uncoated mechanical grades - 20% - 25% for high-quality gravure printing applications and usually below 15% for offset printing.
- Greater use of S/C uncoated mechanical grades. These grades enhance print quality by improving the surface smoothness of papers.

Japan's printing and writing paper consumption has grown rapidly, increasing during the 1970's at a rate of 6% annually, well above that for other industrialized nations. These results are consistent with Japan's high economic growth rates over the period, as illustrated in Table 60.

TABLE 60 JAPANESE CONSUMPTION OF PRINTING AND WRITING PAPER, 1970-1980

	Real GDP Percent Annual Change (constant currency)	Printing and Writing Consumption Percent Annual Change
Japan	4.9	6.0
United States	3.2	3.6
Western Europe	2.9	3.6

Sources: IMF, OECD.

With the expectation that Japan's economy in the 1980's will continue to outperform other major industrialized nations, the outlook for growth in printing and writing paper consumption is favourable. The pace of real GDP growth, however, is expected to be lower in the 1980's, falling below 4%. This will be accompanied by a reduction in the printing and writing paper growth trend to 3.7% per year, with a corresponding annual increase in usage of 180,000 tonnes.

Consumption of printing and writing papers by grade in Japan during the 1980's will shift toward lightweight coated papers (LWC)* at the expense of uncoated mechanical papers. LWC usage will be expanded to reduce grammage of publication and book papers while increasing print quality.

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*LWC paper is generally defined as a coated paper made with 25% or more mechanical pulp and a weight of less than 60gsm (40 lb/ream).

The most rapid growth will be in wood-free papers for business use such as continuous forms papers, reprographic papers and carbonless copy papers. Expansion of these uses alone is expected to add 4% to 6% to Japan's total printing and writing paper consumption in the 1980's.

Production and Capacity

In general, adequate capacity for producing printing and writing papers will be in place to meet demand during the 1980's. Grade imbalances and over-capacity will be evident in some regions during the early part of the decade. By 1985, however, demand and production will have increased sufficiently to provide a worldwide industry operating rate of about 89%, virtually unchanged from the operating rate in 1980 (see Table 61).

TABLE 61 WORLD CAPACITY, PRODUCTION AND OPERATING RATE FOR PRINTING AND WRITING PAPER - 1985

(thousand tonnes)

	Production	Capacity	Operating Rate
North America	18,186	19,220	94
Western Europe*	15,855	18,500	86
Japan	4,831	5,700	85
Eastern Europe	1,064	1,250	85
U.S.S.R.	1,348	1,600	85
Latin America	2,160	2,400	90
Africa	472	510	93
Asia, excluding Japan and China	1,794	2,400	75
China	2,550	2,700	94
Oceania	273	300	91
World Total	48,533	54,580	89
1980 World Total	42,325	47,640	89

Sources: FAO, trade associations, trade publications, SRI.

*Including Yugoslavia

Consumption of printing and writing paper will grow rapidly in comparison to other forest-based products, but several factors unique to these grades will act to assure that capacity is in place to meet these growing demands:

- Printing and writing papers are high-value grades that, on balance, provide a better return on investment than other paper and paperboard products.
- Production additions may be made in smaller increments, requiring smaller capital investments and posing fewer problems in marketing the added capacity.

- Market pulp producers will continue to integrate forward, motivated by a desire to increase the value of products and also to take advantage of the more stable price behavior of printing and writing papers.
- Hardwood pulpwoods are used extensively for production of fine papers. These are more abundant than softwoods and are more widespread geographically, making possible the installation of integrated fine paper mills in most regions of the world.

Worldwide printing and writing paper consumption has grown rapidly, but the industry has over-reacted to optimistic demand projections, leading to temporary over-capacity. Examples of this condition are widespread. Production capacity for paper is currently well above demand levels in Europe, North America, and Japan.

The outstanding feature of the recent and projected growth in printing paper grade capacity in the U.S. is the very large increment in capacity for production of coated mechanical papers to be added during the early 1980's, as illustrated in Table 62. During the period from 1980 to 1985, capacity for coated mechanicals will increase by 36% to over 3.4 million tonnes. Trends in consumption of do not appear to warrant this large increase.

TABLE 62 U.S. CAPACITY FOR PRINTING AND WRITING PAPERS BY GRADE

Grade	Capacity 1980 (thousand tonnes)	Capacity 1985 (thousand tonnes)	Average Annual Rate of Increase 1980-1985 (%)
Uncoated mechanical	1,475	1,600	1.6
Uncoated wood-free	7,845	8,500	1.6
	9,320	10,100	
Coated mechanical	2,505	3,400	6.3
Coated wood-free	2,015	2,300	2.7
	4,520	5,700	
Cotton	125	130	0.8
Thin	345	340	-0.3
Bristols	930	1,050	2.5
	1,400	1,520	
Total	15,240	17,320	2.4

Sources: API, SRI.

Shortages of capacity to produce coated mechanical papers in the late 1970's caused widespread grade substitutions and unusually high U.S. imports. In the early part of the

1980's, however, oversupply in coated mechanicals will tend to change the grade/price structure by decreasing the relative price of coated mechanical paper. This, in turn, will increase consumption by fostering grade substitutions and changes in international trade flows.

Projected 1985 capacity and production for the principal grades are shown in Table 63. Overall, the operating rates are expected to be very good but the competition for markets is expected to lead to periods of less than optimum utilization of capacity during the early 1980's, especially for the coated paper grades and the uncoated mechanical printing grades. Uncoated wood-free paper production is expected to be near to full capacity.

TABLE 63 U.S. PRODUCTION AND CAPACITY, 1985

PRINTING AND WRITING PAPERS

(thousand tonnes)

Grade	Annual Capacity	Annual Production
Uncoated mechanical	1,600	1,420
Uncoated wood-free	8,500	9,600
	10,100	9,600
Coated mechanical	3,400	3,130
Coated wood-free	2,300	2,130
	5,700	5,260
Cotton	130	90
Thin	340	310
Bristols	1,050	950
	1,520	1,350
Total	17,320	16,210

Source: API, trade journals, SRI.

The capacity to produce wood-free paper will increase substantially after 1985. At least one machine, scheduled to start up in 1984, has been delayed beyond 1985, but it should be operating shortly thereafter. Additional U.S. tonnage is also likely to be forthcoming through modernization of existing mill facilities.

As demonstrated in Table 64, Canada will add substantially to its capacity to produce printing and writing papers. Most of the expansion is in the mechanical printing grades. Canadian over-capacity in newsprint in the period to 1985 (see the newsprint section of this report) is leading newsprint producers to increase their production and sales of mechanical printing papers. This grade can easily be manufactured on Canada's older and/or under-utilized machines. However, Canadian mills will face severe competition in U.S. markets from U.S. producers of coated mechanical paper.

TABLE 64 CANADIAN PRINTING AND WRITING PAPER, ANNUAL CAPACITY

Grade	Capacity 1980 (thousand tonnes)	Capacity 1985 (thousand tonnes)	Average Annual Growth Rate 1980-1985 (%)
Mechanical	660	1,060	9.9
Wood-free	980	1,200	4.1
Total	1,640	2,260	6.6

Source: CPPA, Sandwell.

In 1980, approximately 270,000 tonnes of the above total capacity was allocated to coated printing and writing papers. By 1985, the annual capacity for coated papers is expected to increase to about 340,000 tonnes.

Most of the 400,000 tonnes increase in capacity for mechanical grades is expected to result from the conversion of old newsprint machines and from the installation of one new machine. In terms of geographical distribution, 270,000 tonnes of additional capacity will be located in Quebec, 110,000 tonnes in Ontario and 20,000 tonnes in B.C.

Paper mill expansions planned by MacMillan Bloedel Ltd. and Great Lakes Forest Products Ltd. account for most of the increase in wood-free printing and writing paper capacity.

It should be pointed out that Canadian reports of mechanical printing paper capacity are substantially understated. The distinction between the mechanical grades of printing and writing paper and high quality newsprint is not great. Additionally, manufacturers are often unable to correctly identify and report the end-use of newsprint shipments. Consequently, both capacity and production of mechanical printing papers are understated. The output of mechanical printing grades could quickly be doubled if the market could support the increase. This would, of course, be accompanied by an equivalent reduction in newsprint capacity.

Measurement and projection of capacity in western Europe is at best an educated guess because of differing interpretations from country to country of the capabilities of installed paper machines and the problems of identifying the allocation of time on extremely versatile paper machines. As had been noted, grade reporting and grade definitions vary from country to country. These difficulties notwithstanding, it is apparent that no shortage of capacity is likely to occur in the next 5 years or more. Table 65 summarizes projections of production, capacity and operating rates. This shows the overall 1985 operating rate for Europe at a poor 85% level. Considering the mediocre performance of the EEC countries' printing and writing paper producers over the past decade, it is significant that the capacity additions planned will act to exacerbate the oversupply problems.

TABLE 65 WESTERN EUROPEAN PRODUCTION AND CAPACITY FOR PRINTING AND WRITING PAPERS, 1985

(thousand tonnes)

Annual Capacity	Scandinavia	EEC	Other Western Europe	Total
Coated	1,055	4,610	660	6,325
Uncoated	3,930	6,600	1,320	11,850
Total	4,985	11,210	1,980	18,175
Annual Production				
Coated	990	4,023	534	5,597
Uncoated	3,055	5,677	1,196	9,928
Total	4,045	9,700	1,780	15,525

Source: FAO, trade associations, trade publications, SRI.

Note: Other Western Europe excludes Yugoslavia.

Scandinavian countries have pursued a policy of adding value to their exports by converting a larger part of their pulp production to finished paper products. Although the pace of this integration will slow during the next few years, European demand for Scandinavian exports will also grow less rapidly, providing a gloomy outlook for utilization of capacity by Scandinavian companies. The projected 1985 operating rate is barely over 80%.

Of all major industrial nations, Japan has the most serious problem of paper industry over-capacity. In the period from 1977 through 1980, Japanese companies invested heavily in paper machines, each expecting to expand its share of the market. Reports from Japan estimate there is a 30% excess in capacity for producing printing and writing grades.

In 1981, the Japanese industry was permitted to form a "recession cartel", which acted to restrain production and to specify the output of individual companies. The cartel announced an objective for reductions in capacity that will provide an operating rate of 85% in 1985. Even with Japan's rapid growth in consumption, this objective will be difficult to accomplish. In the coated printing grades (see Table 66), it is unlikely that producers will attain a reasonable balance of capacity to demand until 1990, unless there are many permanent machine closures. This prospect seems unlikely in view of Japan's past actions to keep alive failing mills and companies.

TABLE 66 JAPANESE PRODUCTION AND CAPACITY OF PRINTING AND WRITING PAPERS, 1985

(thousand tonnes)

	Production	Capacity
Coated	1,756	2,400
Uncoated	3,075	3,400
Total	4,831	5,800

Source: FAO, trade publications, SRI.

International Trade

The diversity of uses and grades of printing and writing papers contributes unique characteristics to the trade in these products. These characteristics generally act to inhibit trade in these papers:

- Few grades are homogeneous enough to provide large export markets - only coated mechanical and uncoated mechanical printing grades are traded as commodities in the same sense that newsprint and linerboard are traded.
- Virtually all countries, where annual paper consumption exceeds 50,000 to 100,000 tonnes, produce at least part of their national requirements.
- Virtually no country is completely self-sufficient; all import some grades not produced in the country.
- No region or country has a dominant position in the trade by virtue of its low cost of manufacture, superior technology or superior manufacturing base.
- Customer service, product quality and product specifications are important factors in establishing and maintaining trade.

In North America, neither Canada nor the U.S. are major printing and writing exporters beyond the confines of the region. Together, Canada and the U.S. produced 15.6 million tonnes in 1980 and exported under 0.1 million tonnes, or about 0.6% of their total output, to countries outside North America. There is, however, extensive trade between the two countries. Canada provides much of the U.S. supply of uncoated mechanical paper used for printing directories, paperback books, advertising inserts, and catalogues. Canada also supplies the U.S. with lesser quantities of wood-free papers. Canada exported 574,000 tonnes of printing and writing papers to U.S. markets in 1980 which represented 86% of its export tonnage. On the other hand, Canada imported 151,000 tonnes, 95% of which emanated from the U.S., providing a market for half of the U.S. exports.

Canada will also seek to expand export sales of groundwood printing grades. Excess Canadian newsprint capacity, through to 1985 at least, will lead to conversion of smaller, less efficient newsprint machines to the production of mechanical grades. This, plus increased competition between uncoated mechanicals and LWC grades for market share in the U.S., will lead Canada's producers of mechanical printing papers to seek overseas markets aggressively.

Over the long-term, North America is not expected to be a dominant factor in world trade of printing and writing papers. With large domestic markets to serve and few competitive advantages in export markets, U.S. and Canadian producers are expected to concentrate their activities in North American markets. They will seek to increase overseas export sales primarily during periods of over-capacity and then only in the commodity grades in which customer service is less important. If European producers should be unwary and ignore changing market demands, however, North Americans could permanently capture part of the growing European market for coated mechanical printing papers and wood-free business papers.

Few countries are heavily committed to exporting printing and writing grades. The following list indicates the most prominent exporting countries in 1980:

	Millions of Tonnes	Percentage of Total Production
Finland	1.75	86
Canada	0.52	31
Sweden	0.48	48
Austria	0.43	68
Norway	0.15	45

Finland stands out among the exporting countries. Among the five principal exporters, Finland's export tonnage exceeds the combined total of the other four and a very large part, 86%, of its production is sold outside its borders. Finland's production includes large quantities of mechanical printing papers, as reported by Finnpap for 1980, and shown below:

	Percent
Mechanical	
Coated	18
Uncoated	64
Wood-free	
Coated	3
Uncoated	15
	100

World trade in the mid-1980's and beyond is likely to be influenced by the rapid growth in consumption of reprographic papers and continuous forms paper to meet the demands imposed by burgeoning sales of electronic business systems. Growth in use of wood-free plain paper for copiers and continuous stock forms will provide large markets for commodity grade paper. Integrated producers with high speed paper production and converting facilities will have growing cost advantages over smaller producers who are frequently dependent on costly market pulp supplies. Thus, Scandinavian and North American exports of these grades of paper will expand in the 1980's and are likely to capture a major share of the market from non-integrated wood-free paper producers in the 1990's.

Price Considerations

Since printing and writing papers are sold in the U.S. markets on a short ton basis, the prices presented in this section are quoted accordingly. In addition, the basis weight of printing and writing papers is stated in imperial units. (See Appendix I for metric equivalents.)

At the end of 1982, prices of typical printing and writing papers in the U.S. ranged from about US$600 to US$1,650 per short ton, as illustrated in Table 67. Uncoated mechanical papers are the most economical grades for general printing applications. At the other end of the price spectrum are fine bond papers used for high quality office stationery. It should be noted that many grades are, at present, sold at substantial discounts from the prices shown in the table.

Of particular interest to this study is a price differential between S/C uncoated mechanical and coated No. 5 mechanical, since these grades compete in several applications, especially in magazine publishing.

In general, No. 5 coated publication paper tends to be more profitable since the production cost of this grade is approximately US$90 to 100 per short ton higher than S/C mechanical, but the price differential is in the order of US$125 per short ton.

TABLE 67 PRICES OF PRINTING AND WRITING PAPERS IN THE UNITED STATES, DECEMBER 1982

	Price (U.S. dollars per short ton)
Uncoated Mechanical	
Directory, 22.5 lb., white	650
Directory, 22.5 lb., yellow	680
Catalog, 25 lb., roto	600
Supercalendered, 34 lb.	635*
Coated Publication	
No. 1, 70 lb., sheets	1,200
No. 3, 60 lb., rolls	950*
No. 5, 32-36 lb., rolls	760*
Uncoated White (wood-free)	
Bookpaper, No. 3 offset, 45 lb., sheets	878*
Bond, No. 4, unwatermarked, 20-24 lb., sheets	867*
No. 1, watermarked, 20 lb., sheets	916*
Form bond, 15 lb., rolls	700/753*
Bond, 25% cotton, sheets	1,650

*Discounting has been reported.

Source: P&P Week.

There are many factors that affect the price level of printing papers such as brightness, finish, strength, basis weight, smoothness, opacity, quantity of purchase, form (cut into sheets or sold in rolls), etc. However, the relative prices of the principal paper grades tend to remain consistent over time as illustrated in Table 68. The variation in the relative price of individual grades can be attributed mainly to the supply/demand balance in a particular period time. For example, the shortage in supply of lightweight coated mechanical (No. 5) papers between 1976 and 1981 allowed the price to rise more rapidly than the price of other grades. Conversely, in the last two years, the same grade has suffered from an over-capacity which is reflected in the price as demonstrated on Table 68.

TABLE 68

UNITED STATES PRICES FOR PRINTING AND WRITING PAPERS

(US$ per short ton)

	Uncoated Mechanical		Coated Publication			Uncoated White (wood-free)		
Year-End	Premium Roto News (30 lb.)	Catalogue Roto (25 lb.)	No. 1 Sheets (70 lb.)	No. 3 Rolls (60 lb.)	No. 5 Rolls (32-36 lb.)	Bookpaper No. 3 Offset, Sheets (45 lb.)	Forms Bond Rolls (15 lb.)	Bond 25% Cotton, Sheets
1970	*	*	*	*	*	442	*	*
1971	*	*	*	*	*	455	*	719
1972	*	175	*	*	*	460	*	728
1973	*	200	*	*	*	457	*	734
1974	*	320	*	574	378	535	*	984
1975	*	320	*	584	399	484	500	1,012
1976	*	345	*	643	460	506	520	1,083
1977	330	405	*	702	532	552	475	1,143
1978	375	425	893	712	582	645	544	1,210
1979	404	468	970	786	671	714	620	1,325
1980	475	515	1,038	858	735	813	697	1,490
1981	508	551	1,130	920	760	878	753	1,650
1982	517	600	1,200	950	760	878	753	1,650

Sources: P&P Week, P&P Week Data Book.

*Not available.

Assessment of Marketing Opportunities

As has already been discussed, the printing and writing papers category encompasses a wide variety of papers. Markets for these grades are characterized by a limited number of large buyers and a high level of competition in terms of price and quality. For merchandising reasons, the production of printing and writing papers usually requires a wide range of grades in terms of basis weight, finishes, colours and sizes. However there are a few homogeneous grades which are produced in large volumes and sold as commodities in open markets. These include, for example, the BMDX (bond, mimeograph, duplicating and copy) grades which are similar in sheet properties and basis weights. Many mills make the same paper for more than one end-use and commonly swing between grades depending on the demand for particular products. These grades, which are also commonly used for offset printing, are generally made from 100% bleached chemical pulp (usually 50/50 softwood/hardwood) and are classified as uncoated wood-free papers. Other examples of large volume commodities could be found in mechanical printing and writing paper category - grades such as uncoated groundwood publication (e.g., telephone directory paper, catalogue paper, etc.) and LWC groundwood paper used in magazine publishing.

In order to produce such grades, a market would need to be developed for a paper machine which would produce between 300 and 500 tonnes per day. For a mill located in Alberta or B.C., such a market could only be found in the U.S. since Canadian markets are very limited and well served by current suppliers. Currently, a supplier located in Alberta or the B.C. interior would be at a disadvantage vis-a-vis the coastal suppliers in selling to offshore markets.

Future consumption of printing and writing papers in the U.S. by major grade, as estimated by SRI, is shown in Table 69. Consumption of coated mechanical grades is projected to increase at an average annual growth rate of 3.2%, uncoated wood-free consumption is estimated to grow at 2.8% annually, whereas uncoated mechanical grades are projected to expand at 2.6% per annum. Consumption of all remaining grades is expected to grow at rates lower than that of the aggregated total.

TABLE 69

UNITED STATES CONSUMPTION OF PRINTING AND WRITING PAPERS BY GRADE AND PRINCIPAL PRODUCTS

	Consumption 1980 (thousand tonnes)	Consumption 1990 (thousand tonnes)	Increase (decrease) 1980-90 (thousand tonnes)	Average Annual Growth Rate 1980-90 (%)
Uncoated				
Wood-free: Commercial printing Business forms Office papers Envelopes Books	7,256	9,560	2,304	2.8
Mechanical: Periodicals other than magazines Commercial printing Business forms	1,705	2,201	496	2.6
Coated				
Wood-free: Commercial printing Magazines	1,914	2,341	427	2.0
Mechanical: Magazines Commercial printing Periodicals other than magazines	2,332	3,193	861	3.2
Bristols Tabulating cards Tags Index cards File folders	884	926	42	0.5
Thin Carbonizing Books (reference, text, technical)	286	313	27	0.9
Cotton Bond and writing papers Technical	99	91	(8)	(0.8)
Total printing and writing	14,476	18,625	4,149	2.6

Source: Trade sources, SRI.

Most of the U.S. demand for the mechanical coated grades is supplied by LWC groundwood paper. Taking into account the fact that the American Paper Institute consumption statistics classify some LWC No. 4 paper under coated wood-free (rather than coated mechanical), it is estimated that the total U.S. consumption of LWC groundwood paper for all end-uses was approximately 2.2 million tonnes in 1980. As already mentioned, the U.S. has an oversupply in coated mechanical grades and, in our view, this imbalance will last at least until the mid-1980's.

However, a preliminary analysis of the supply/demand balance for lightweight coated mechanical papers in the western U.S. region shows a different picture. This region is seriously deficient in production and is expected to continue to be supplied from other U.S. regions and from western Canada, providing that Canadian suppliers can be competitive.

According to Sandwell's estimates, demand for LWC mechanical paper in the western U.S. will increase from approximately 180,000 tonnes in 1980 to about 450,000 tonnes in 1990. Strong growth in demand for LWC groundwood papers is expected from catalogues and newspaper advertising inserts segment of printing industry. The desirability of good quality colour reproductions will further improve market share of LWC mechanical papers for these end-uses.

The only production capacity located in the western U.S. region is at West Lynn, Oregon, and is owned by Crown Zellerbach. It is estimated that this mill supplied about 80,000 tonnes or 44% of the regional consumption in 1980. The remaining tonnage of 100,000 tonnes was supplied by producers located in other U.S. regions. Crown Zellerbach (St. Francisville, La.), Blandin Paper Co., Consolidated Papers and St. Regis Paper are major suppliers to the western U.S. region at present.

Since no firm commitments to build additional LWC mechanical paper capacity within the western U.S. region have been announced, this region is expected to increase its deficiency by approximately 350,000 tonnes annually in 1990. From this point of view, the western U.S. market is rather promising for a supplier in Alberta or the B.C. interior because of competitive freight costs vis-a-vis some U.S. suppliers. However, the import duty to the U.S. might offset any advantage gained from lower freight costs. Furthermore, the lack of a local supply of coating materials in the region under review will, to some extent, affect the economic viability of production of LWC papers.

It should be noted that LWC mechanical paper is technically one of the most demanding grades to produce. Any newcomer to the field ought to consider some form of joint venture with a current producer to obtain expertise.

Logically, a papermill located in Alberta or B.C. ought to be fully integrated with a pulp mill to take advantage of the raw material base. It should be pointed out that, to produce any grade of printing and writing paper, at least 30% of the furnish will have to be bleached kraft pulp which, due to the economics, should be made on the premises rather than purchased. A base stock for LWC mechanical paper produced in Alberta or B.C. could probably contain 60% - 65% mechanical pulp and 35% - 40% of bleached kraft pulp. How much aspen based pulp (e.g., chemical pulp) could be included in the furnish can only be determined in extensive tests. Minimum annual production from a new machine would be of the order of 150,000 tonnes. It is expected that up to 20,000 tonnes could be sold in western Canada in 1990, providing that no other new supplier enters this market. The balance of production destined for the western U.S. region would represent about a 28% share of this market.

In summary, based on this preliminary evaluation of market analysis, a very good opportunity exists for a least two new machines producing LWC mechanical papers to be installed in the western part of North America by 1990. Although some pulp and paper companies located within the region are known to be contemplating capacity expansions, no commitments have been made as yet. Whether or not a mill located in Alberta or the B.C. interior would, in fact, be competitive in the aforementioned markets could only be determined by a detailed feasibility study.

PULP AND PAPER

General

In selecting pulp and paper products which would satisfy the study objective and comply with the aforementioned guidelines, a set of criteria was applied which related to both the technical suitability of the available poplar resource and to the viability of selling potential products in the open market. The following products are recommended for further investigation:

- bleached hardwood sulphate market pulp
- mechanical market pulp
- newsprint
- printing and writing papers

The remaining pulp and paper products either are not viable technically or do not presently meet market-related criteria.

Conclusions

The following conclusions and recommendations have been drawn from the market assessment carried out for each of the selected grades.

1. No significant market-related constraints appear to exist with regard to bleached kraft aspen pulp. In terms of its physical properties, such pulp would be at least as good as or, possibly, better than European beech pulp and North American mixed hardwood pulps in most applications.

2. The primary regional market opportunities for bleached kraft aspen pulp manufactured in either the B.C. interior or Alberta are the mid-west and western regions of the U.S. Secondary opportunities exist in Asia, particularly in Japan.

3. The utilization of bleached grades of market mechanical pulps will probably continue to increase in all major markets including western Europe, the U.S. and Japan. This increase will apply particularly to paper grades such as printing and writing papers, tissue and household products and, to some extent, bleached board.

4. For reasons of location and the resulting transportation cost factors, the U.S. offers the best market opportunity for bleached mechanical pulp based on aspen. The tissue and household paper products sectors should be the primary target markets, as firms manufacturing these products remain virtually non-integrated and hence dependent on outside suppliers of pulp. The manufacturers of other product groups which utilize bleached mechanical pulps, such as bleached board and some grades of printing and writing papers, are becoming increasingly integrated and thus offer less potential for a market pulp producer. Nevertheless, these sectors still offer some opportunities and should not be overlooked in any subsequent detailed market study.

5. A market potential exists offshore for bleached mechanical pulp in Japan and, to a lesser degree, in South Korea and Taiwan. The commercial viability of exploiting these markets would be largely a function of ocean freight costs which would need to be examined in depth.

6. In the next two to five years, the market prospects for a newsprint mill located in Alberta or the B.C. interior are not promising due to over-capacity in North America. The imbalance will further intensify competition for markets in North America, as well as offshore, since capacity will continue to be substantially greater than demand. However, the long-term prospects, i.e., from 1987 - 1988 on, are promising. In order to supply the projected world newsprint demand, six million tonnes of new capacity, or approximately 25 new modern newsprint machines, will be required over the period 1985-1995.

7. The mid-west and western regions of the U.S. are considered to be the major potential markets for a newsprint mill located in the study area. In addition, a small portion of production could be sold in the Prairie provinces with only marginal tonnages shipped to offshore markets.

8. In order to produce a relatively homogeneous grade of printing and writing papers, a market would need to be developed for a paper machine which would produce between 300 and 500 tonnes per day. For a mill located in Alberta or the B.C. interior, such a market could only be found in the U.S. because Canadian markets are very limited and well served by current suppliers. In addition, a mill situated in the regions under review would be at a disadvantage vis-a-vis coastal North American mills in servicing offshore markets.

   A preliminary assessment of the U.S. market revealed that, in spite of an oversupply of coated mechanical grades, which is expected to prevail on a national level until the mid-1980's, the western region of the U.S. is in a deficit position. At present, approximately 100,000 tonnes or 55% of the LWC mechanical papers consumed in the West annually is supplied from other U.S. regions. By 1990, the demand for LWC mechanical papers is projected to increase by an additional 270,000 tonnes per annum, which, when combined with current shipments into the region, suggests an opportunity for two new machines within the western U.S. or in western Canada. Whether or not a mill producing LWC mechanical papers located in Alberta or the B.C. interior would be competitive in the identified markets could only be determined in a detailed feasibility study.

Recommendations

In the absence of key technical and economic variables, it is not possible to identify which product is most suitable for manufacture in Alberta or the B.C. interior. However, based strictly on selection criteria previously outlined and the subsequent preliminary market analysis, it appears that both the bleached aspen sulphate market pulp and mechanical market pulp should be given higher priority than newsprint or LWC mechanical papers in future planning.

Any follow-up study of market opportunities for pulps based on the poplar resources should also take into account the softwood resources of the region under review. Both newsprint and LWC mechanical papers will require that a portion of the furnish be made up from partly or fully bleached softwood pulp. Therefore, the ability to mix hardwood and softwood bleached kraft market pulp would broaden the spectrum of end-uses, particularly in the area of specialty papers. In terms of bleached mechanical pulps, a mix of hardwood and softwood species will likely enhance the quality characteristics and, consequently, the market acceptance.

PULPWOOD

Introduction

Wood-fibre furnish for pulp production is derived from three major sources - roundwood (logs), wood chips and re-cycled paper. This section of the report presents a discussion of roundwood pulp furnish. Wood chips and re-cycled paper are discussed in other sections. International standards which define pulpwood logs, as opposed to sawlogs, do not exist but in general, pulpwood logs are those logs which, because of small diameters or low quality, are considered unsuitable for either lumber or veneer manufacture. The term pulpwood as used in this analysis therefore refers to roundwood intended for use primarily in pulp production.

Information on which the discussion is based was obtained from previously published reports, government and private agency statistics, reports and analyses published by research institutes, interviews with manufacturers, distributors, agents, transportation and trading companies and CHI's records.

As with virtually all forest products, the existing domestic or local market would be incapable of absorbing substantial volumes of poplar pulpwood and export sales would have to be considered an essential element to any poplar pulpwood development. For this reason, world production and consumption trends are significant considerations to this study and these trends are examined first in the discussion following.

Product Selection

One of the principal difficulties in attempting to establish standards which define pulpwood is the fact that almost any form of wood or wood residue may be used for pulp production. In most regions with substantial timber reserves, primary pulpwood (roundwood generally) is usually recognized as those trees of small diameter and/or low quality occasioned by tree shape or decay incidence. Frequently, however, large diameter trees of sawlog quality are used as pulpwood.

Residue from log processing units such as sawmills, plywood and furniture producing plants, in either roundwood or block form, is also used as pulpwood and this material constitutes an important component of total pulp furnish. However, for the purposes of this study, the term "pulpwood" refers only to fibre obtained directly from roundwood logs.

Regional Markets

Traditionally, the yield from the world's forests flows to two principal competitive end-uses: fuelwood and industrial wood. Industrial wood provides the raw material for the manufacture of the entire range of forest products, and the term fuelwood is self-explanatory. World demand for fuelwood is increasing at a steady rate and this demand is no longer confined almost exclusively to third world countries, but has become a significant demand element in the industrialized regions over the past several years. The relative rate of growth in fuelwood production, compared with that of industrial roundwood, is shown in Table 70 and graphically represented in Figure 1 for the period 1950-1980.

TABLE 70 WORLD FUELWOOD, PULPWOOD AND INDUSTRIAL ROUNDWOOD PRODUCTION, SELECTED YEARS

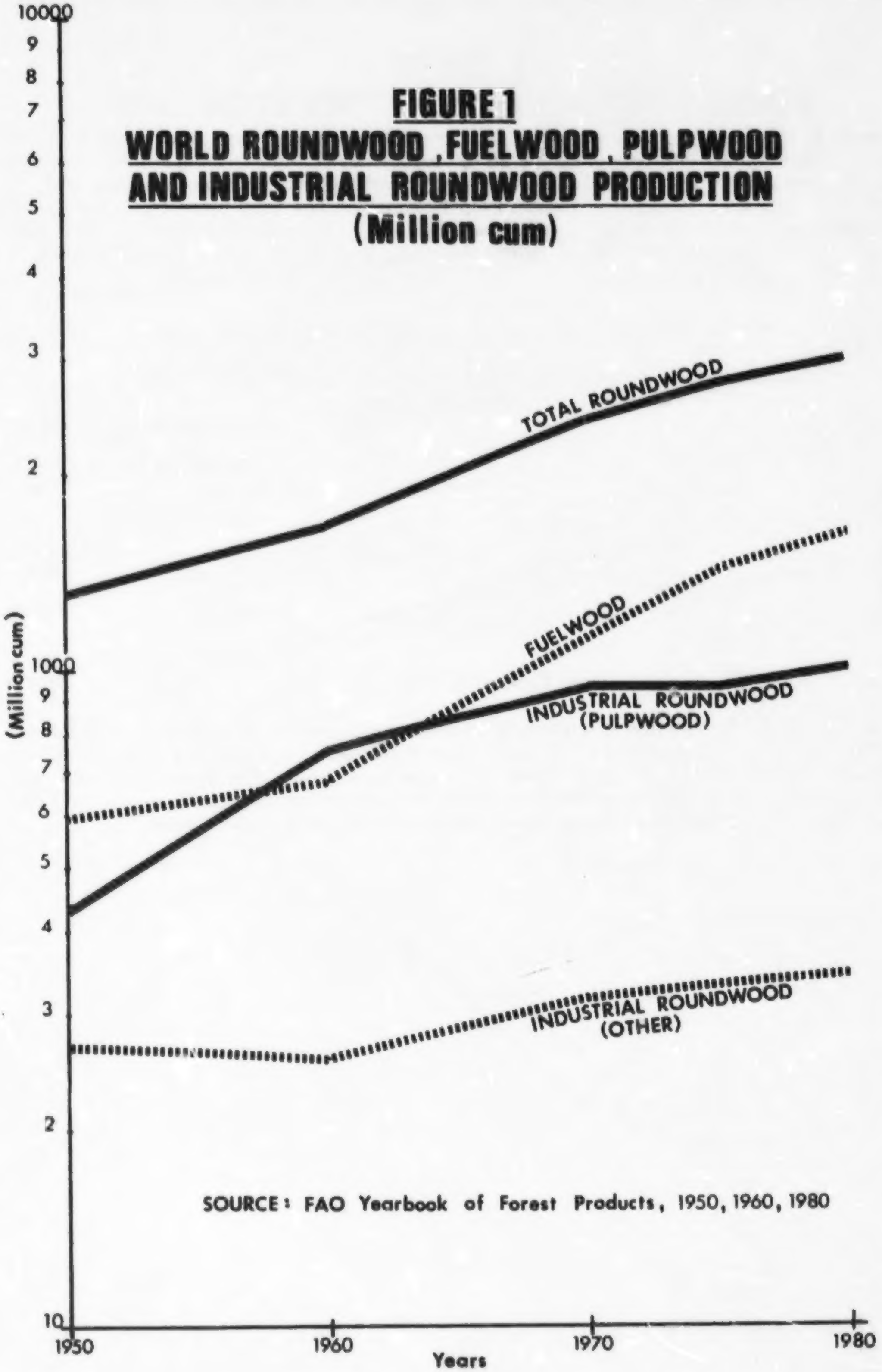
(million cum)

Year	Total Roundwood	Fuelwood	Industrial Roundwood Pulpwood	Industrial Roundwood Other
1950	1,307	597	269	441
1960	1,691	673	257	761
1970	2,396	1,120	313	963
1975	2,757	1,476	323	958
1980	3,020	1,627	341	1,052

Source: FAO, Yearbook of Forest Products, 1950, 1960, 1980.

Over the period shown, total roundwood and industrial roundwood production increased at almost equal rates, approximately 2.8% per annum, but fuelwood's growth rate averaged 3.4% per annum over the same period. Consequently, by 1980, 54% of the yield of world forests was used for fuel compared to 46% in 1950. Since virtually all fuelwood could b used as pulpwood (and vice versa), the increasing demand pressure for wood fuel will obviously affect the volumes available as pulpwood.

FIGURE 1
WORLD ROUNDWOOD, FUELWOOD, PULPWOOD AND INDUSTRIAL ROUNDWOOD PRODUCTION
(Million cum)



SOURCE: FAO Yearbook of Forest Products, 1950, 1960, 1980

Although world wood residue production data are not available, there is no doubt that the portion of total pulp fibre demand supplied by residue has been increasing steadily and will probably continue to do so. This is particularly true for industrialized regions such as North America, even though the trend in North America has been away from the use of roundwood for fuel as shown in Table 71 and Figure 2. The increased share of total pulp furnish taken by wood residue in North America and other industrialized regions is discussed in a following section.

TABLE 71 TOTAL NORTH AMERICAN FUELWOOD, PULPWOOD AND OTHER INDUSTRIAL ROUNDWOOD REMOVALS, SELECTED YEARS

(million cum)

Year	Total Roundwood	Fuelwood	Industrial Roundwood Pulpwood	Industrial Roundwood Other
1950	368	64	82	223
1960	407	49	114	244
1970	451	21	150	280
1975	419	19	133	267
1980	484	20	148	316

Source: FAO, Yearbook of Forest Products, 1950, 1960, 1980.

The decline in the proportion of roundwood forest yield used as fuel is readily apparent. In 1950, fuelwood accounted for 17% of total yield, but by 1970 this proportion had declined to approximately 4% and appears to have remained stable from that point on. Both pulpwood and other industrial roundwood accounted for increased shares of total forest yield and by 1980 these shares amounted to 31% and 65% respectively.

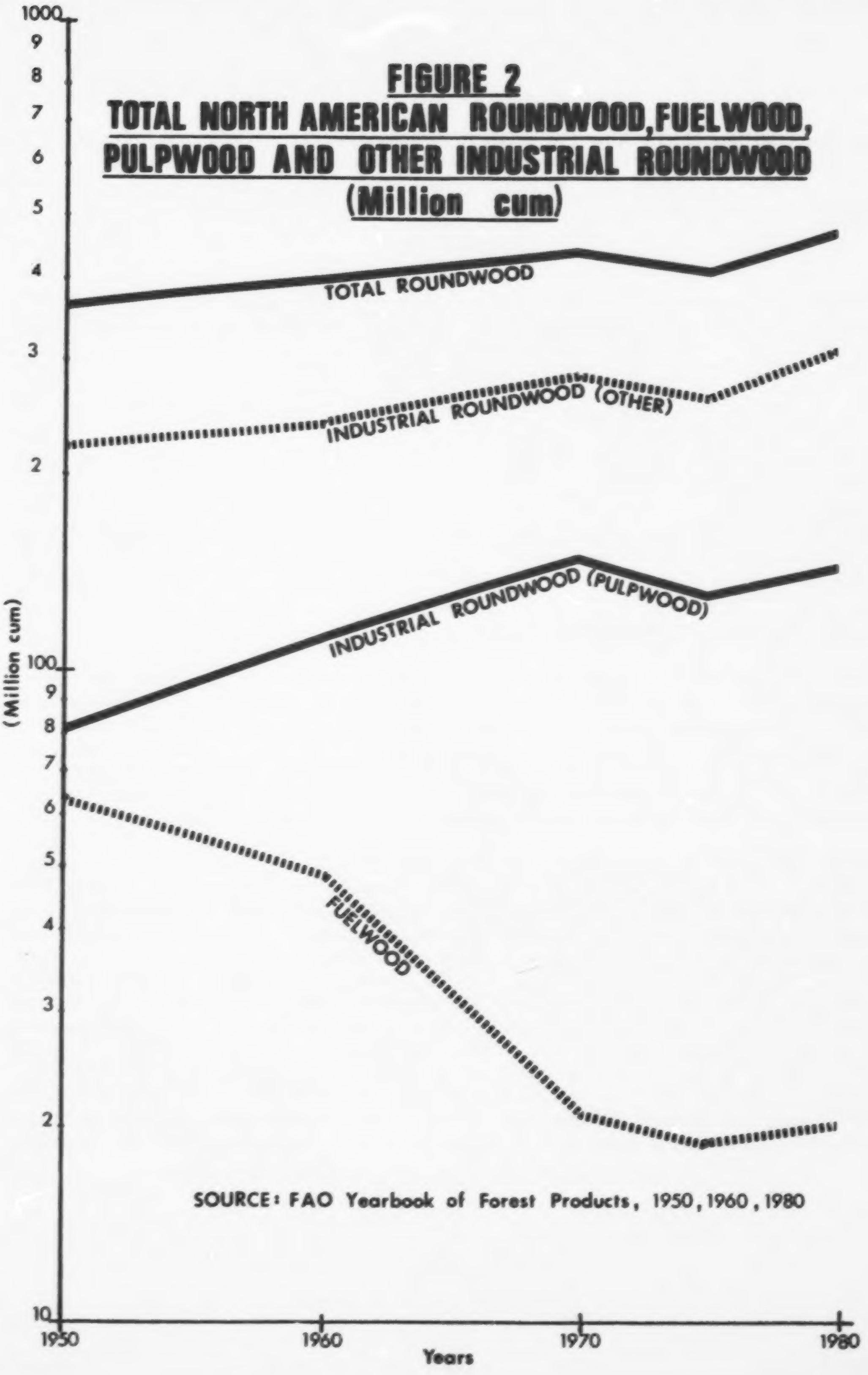


FIGURE 2
TOTAL NORTH AMERICAN ROUNDWOOD, FUELWOOD, PULPWOOD AND OTHER INDUSTRIAL ROUNDWOOD (Million cum)

SOURCE: FAO Yearbook of Forest Products, 1950, 1960, 1980

Trade flows within North America and inter-regionally are of primary importance in assessing potential markets for poplar pulpwood and these are shown in Table 72.

TABLE 72 DIRECTION OF TRADE, PULPWOOD, 1970 and 1980

(thousand cum)

		1970	1980
W. Europe	W. Europe	5,770	6,078
U.S.S.R.	W. Europe	3,855	4,633
E. Europe	W. Europe	2,461	1,615
Canada	U.S.	1,623	470
U.S.S.R.	E. Europe	1,264	745
Canada	W. Europe	1,012	-
Canada	E.E.C.	-	396
U.S.S.R.	Japan	767	894
Far East	Japan	287	-
U.S.	Canada	130	360
U.S.	Japan	64	-
Other	Other	1,104	4,263
Total		18,337	19,463

Source: FAO, Yearbook of Forest Products, 1970, 1980.

Western Europe obviously constitutes the major world market for pulpwood, accounting for approximately 71% of total imports in 1970 and 63% in 1980. The parochial nature of world trade in pulpwood is clearly evident in Table 72. At least 80% of all trade was intra-regional either within Europe or North America. This intra-regional trade could include pulpwood shipped from the U.S.S.R. to western Europe and Japan since this material is not subject to high transportation costs. As will be shown later, transportation costs exert a dominant influence on the marketing and distribution of pulpwood.

Although western Europe constitutes the world's leading market for pulpwood, competition from major supply sources within Europe (Scandinavia and Eastern Bloc countries principally) and from the U.S.S.R. would undoubtedly generate uneconomic sales returns for pulpwood producers located in western Canada. The export markets most likely to provide adequate returns are the U.S. and Japan. As a short-fibre species,poplar falls into the hardwood category and, in both countries, the share of total pulpwood requirements accounted for by hardwoods has remained reasonably constant over the past decade, amounting to approximately 30% (37 million cum) in the U.S. and 50% (16 million cum) in Japan. Whether the U.S. pulp industry will increase the hardwood portion of total pulpwood to equal the proportions utilized in Japan is not known but, as with other products, availability and cost will be the critical considerations. The balance between internal supply and demand will also act as a potential market determinant and Japan's growing deficit position is illustrated in Table 73. Figure 3 contains these data in graphic form.

TABLE 73

JAPAN
PULPWOOD CONSUMPTION, SELECTED YEARS
(million cum)

	Domestic Supply			Imports			Total
Year	Softwood	Hardwood	Total	Softwood	Hardwood	Total	All Species
1960	6.5	4.5	11.0	0.2	-	0.2	11.2
1970	7.3	15.3	22.6	4.4	0.9	5.3	27.9
1975	6.6	10.4	17.0	7.9	3.9	11.8	28.8
1978	6.6	10.3	16.9	8.8	4.5	13.3	30.2
1979	7.1	10.7	17.8	9.9	5.3	15.2	33.0
1980	7.9	10.8	18.7	9.5	6.1	15.6	34.3

Source: Pulp & Paper Statistics, 1981, Japan Paper Association.

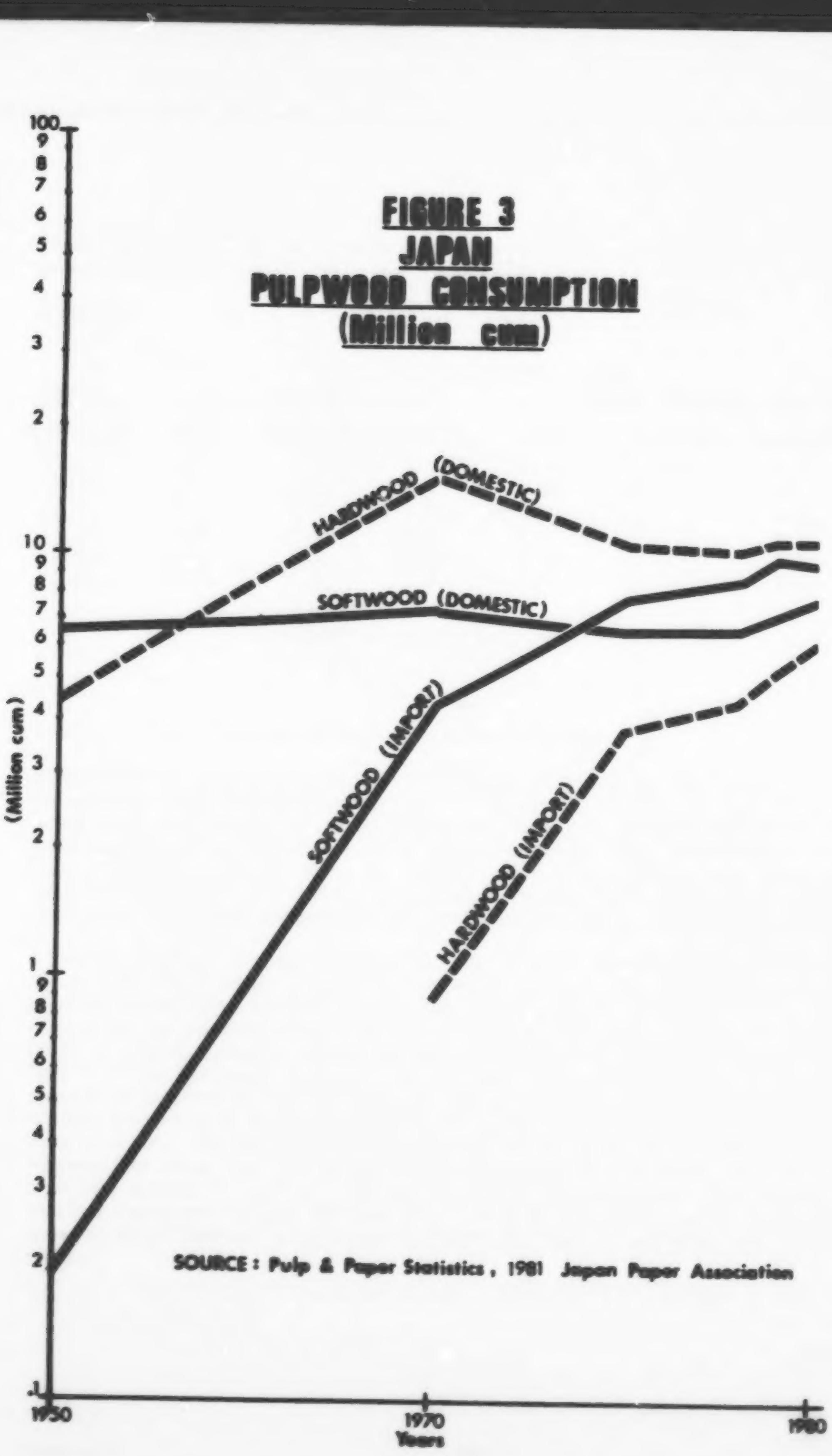


FIGURE 3
JAPAN
PULPWOOD CONSUMPTION
(Million cum)

SOURCE: Pulp & Paper Statistics, 1981 Japan Paper Association

Japan's increased dependency on imported pulpwood is clearly evident, increasing from approximately 2% in 1960 to 45% by 1980. Hardwood's share of total imports increased from 16% to almost 40% between 1970 and 1980, reflecting a dramatic average annual increase of approximately 21%. Virtually all of this material consisted of high density, mixed tropical hardwoods.

The proportion of hardwoods utilized by the Canadian pulp industry is considerably less than in either the U.S. or Japan, as illustrated by the data in Table 74.

TABLE 74

CANADA
PULPWOOD CONSUMPTION BY PROVINCE
1980

(million cum)

Species	Quebec	Ontario	British Columbia	Other	Total
1970					
Softwood	11.7	10.3	6.6	11.8	40.4
Hardwood	1.4	1.4	N	1.2	4.0
Total	13.1	11.7	6.6	13.0	44.4
1980					
Softwood	16.3	9.4	8.6	10.0	44.3
Hardwood	1.4	1.8	0.2	0.7	4.1
Total	17.7	11.2	8.8	10.7	48.4

Source: Statistics Canada, Pulp & Paper Mills, 1970, 1980.

It is clear that the share of pulp furnish taken by hardwoods has remained fairly constant at approximately 10% of total use. In B.C., the current share is insignificant and in Alberta is virtually nil. The reasons are varied and complex and are addressed in considerable detail in the pulp and paper section of this report.

Total pulpwood and wood residue consumption in Canada increased at an average rate of 3.9% per annum over the past three decades - from 28 to 87 million cum in the period 1950-1980. As shown in Table 75, however, most of this increase in demand was accommodated by increased volumes of wood residue and not roundwood pulpwood. This dramatic increase is further represented in Figure 4.

TABLE 75 CANADA

PULPWOOD AND WOOD RESIDUE CONSUMPTION

SELECTED YEARS

(million cum)

Year	Total	Roundwood Volume	Roundwood Percent	Wood Residue Volume	Wood Residue Percent
1950	28.0	27.5	98	0.5	2
1960	38.3	34.0	89	4.3	11
1970	65.7	48.3	74	17.4	26
1975	63.6	39.5	62	24.1	38
1980	87.0	45.2	52	41.8	48

Source: Canadian Pulp and Paper Association, Reference Tables, 1981

The increased use of wood residue by the Canadian pulp industry is directly cost-related. As logging, transportation and wood preparation costs have escalated sharply over the past several years, by-product residue resulting from manufacturing operations (primarily sawmills) has become increasingly attractive economically, and the sale of by-product fibre has become a significant element of the forest products industry. The revenue increase afforded pulp producers by utilization of residue fibre constitutes one of the major obstacles to increased use of roundwood pulpwood of any species by the pulp industry.

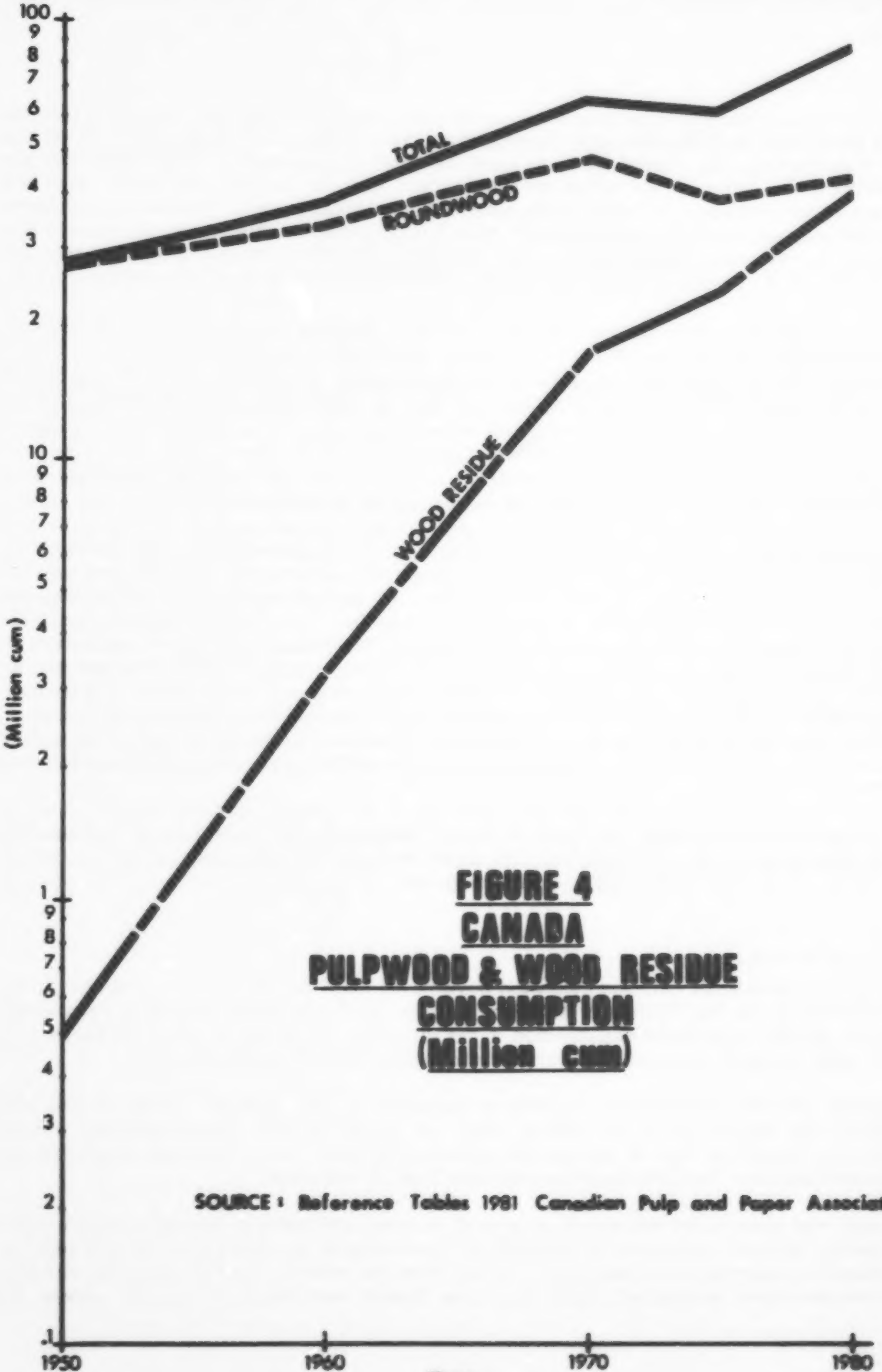


FIGURE 4
CANADA
PULPWOOD & WOOD RESIDUE CONSUMPTION
(Million cum)

SOURCE: Reference Tables 1981 Canadian Pulp and Paper Association.

From the foregoing discussion, a reasonable conclusion is that Canada is unattractive as a potential market for meaningful volumes of poplar pulpwood. Not only has the acceptance of hardwoods remained extremely low, but the use of roundwood generally appears to have reached a plateau. Both the U.S. and Japan appear to present much more attractive opportunities for development, due to the degree of hardwood acceptance and usage of roundwood. Transportation costs, however, to both of these regions will strongly affect the marketability of pulpwoods and are discussed in a following sub-section.

End-Use Market

Pulpwood may be used for a variety of end-uses including energy, chemical and cattle feed production, but to date its principal uses are for pulp and particleboard production. Until the recent installation of substantial waferboard capacity in North America, use of poplar was confined almost entirely to Europe, in particular Italy. Estimates of roundwood consumption by the particleboard industry are not available because most board products are from residue fibre and do not require furnish in log form.

Waferboard requires roundwood of at least pulpwood quality and size; i.e., small diameter, odd shape and a reasonabe limit of decay or stain. Currently installed waferboard capacity in North America requires a log input of approximately 4.5 million cum per annum, of which 1.7 million cum is required in Canada. All of these recently installed plants are concentrated in the poplar supply regions of North America and represents an added demand on poplar timber reserves. This is an important consideration as the demand by the waferboard industry, operating at full capacity, will amount to approximately 50% of the total hardwood pulpwood presently used by the Canadian pulp industry. However, western Canadian pulp producers use virtually no poplar and only two waferboard plants are in operation in western Canada. One additional unit is under construction in Alberta.

For all practical purposes, the pulp industry represents the only logical end-use for substantial volumes of pulpwood. At this time, western Canadian pulp producers appear very reluctant to introduce poplar into the pulp mix.

Quality Standards

International standards defining pulpwood have never been established. As a general rule, log diameter is the key factor for segregating pulp logs from other industrial roundwood. Logs are usually considered as pulpwood if the diameter of the log is too small (usually 20 cm or less) to permit economic conversion into higher-value forest products.

A second general criteria for classifying pulpwood is the general quality of the log, including the degree of crook, sweep, split and other obvious characteristics. Since almost any quality or size of log can be pulped, logs which are completely unsuitable for other end-uses are classified as pulpwood regardless of diameter.

The size and quality definitions of pulpwood in most contracts is agreed between buyer and seller, without reference to national or international grading rules. In all regions, pulpwood is classified more for what it is not, than for what it is. For example, virtually all end-users have established fairly rigid and closely monitored sawlog and veneer log standards and any log which does not meet those standards automatically becomes a pulp log at a lower value. In fact, Japanese importers have established and enforced log quality standards which result in up to 20% sawlog recovery from pulp log imports.

In summary, the definition of grading standards to be applied to poplar pulp logs would have to be agreed to with potential purchasers. Established industry practice could be used as a guide but detailed criteria would have to be developed to suit the requirements of the market.

Technically, poplar's characteristics tend to make the species more suitable for pulping than for other purposes, but a significant increase in poplar use by the pulp industry in western Canada appears to be unlikely, and economic considerations inhibit the use of poplar in other regions. This latter point will be elaborated on in a following section.

Competitive Products

Almost any source of fibre could be considered a competitor to pulpwood. This includes agricultural fibre such as bagasse, wheat straw and others. In practical terms, however, all the softwood species constitute the major competitive material to poplar roundwood. In addition, as has already been shown, by-product wood residues are also major competitors.

In the eastern Canadian and U.S. pulpwood markets, where poplar and other hardwoods have achieved a much higher degree of acceptance than in the western regions, locally produced pulpwood (including poplar) would also constitute a serious competitive challenge to western Canadian material. Traditionally, pulpwood has been considered a low value product and unable to absorb long-distance transportation costs which preclude western produced pulpwood from use in eastern regions.

As one of the world's leading users of hardwood for pulp furnish, and as a region increasingly dependent on imported fibre, Japan may appear to be a natural market for poplar pulpwood. However, as shown in Table 76 and Figure 5, imports of hardwood logs as pulpwood have declined sharply over the past decade or so.

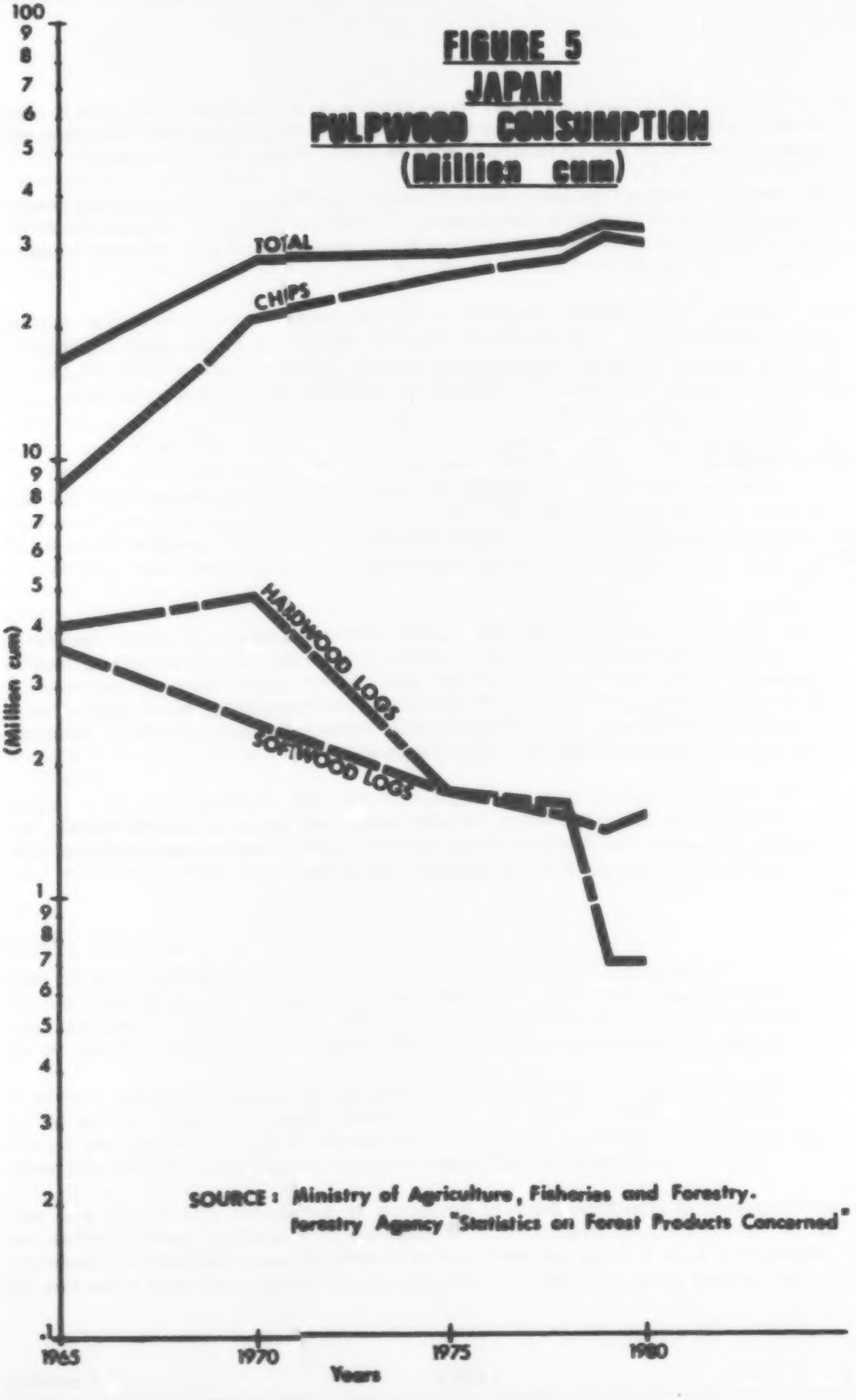


FIGURE 5

JAPAN

PULPWOOD CONSUMPTION

(Million cum)

SOURCE: Ministry of Agriculture, Fisheries and Forestry.
Forestry Agency "Statistics on Forest Products Concerned" 1982

TABLE 76

JAPAN
PULPWOOD CONSUMPTION, SELECTED YEARS

(million cum)

Year	Total	Logs Softwood	 Hardwood	Chips
1965	16.6	3.7	4.2	8.7
1970	28.3	2.5	4.8	21.0
1975	28.8	1.7	1.7	25.4
1978	31.1	1.5	1.6	28.0
1979	33.6	1.4	0.7	31.5
1980	32.7	1.5	0.7	30.5

Source: Japan, "Statistics on Forest Products Concerned", Ministry of Agriculture, Fisheries and Forestry, Forestry Agency, 1982.

The declining use of logs as pulp furnish is apparent. In 1965, logs accounted for over 50% of total consumption but, by 1980, the proportion of logs used had declined to 6%. Additionally, the major portion of the decline was absorbed by hardwoods which, by 1980, constituted only 2% of total pulpwood used. In addition to increased competition from chips (the majority now imported into Japan), poplar pulpwood from western Canada would face competition from poplar produced in the U.S.S.R. Poplar logs have been imported from the U.S.S.R. on a sporadic basis for many years and whether or not the volumes of these imports could be increased enough to meet a major demand increase is uncertain. Most Japanese interviewed, however, expressed grave reservations regarding the U.S.S.R. as a dependable supply source. Past experience has apparently shown Russian shippers to be unreliable regarding shipping schedules and quality standards, and it is obvious that Japanese importers prefer not to rely on the U.S.S.R. for any significant volume of supply.

Competition in western Europe would stem primarily from softwood suppliers, but also from poplar suppliers in both eastern and western Europe. Total pulpwood shipped from east to west Europe remained fairly constant at 6 million cum during the 1970's, but the poplar proportion of the total has not been identified and whether or not the use of poplar as pulp furnish is increasing or decreasing is not clear. Opinions obtained in Europe indicate that the volumes are remaining constant, and unless a supply shortage develops, economics - and not supply - will continue to limit the potential for western Canadian suppliers of pulpwood to the European market. One of the key economic factors is transportation costs which are discussed in a following sub-section.

Distribution Mechanics

In common with chips, the number of "middlemen" involved in the distribution of pulpwood is minimal. Most contracts are negotiated directly between pulpwood producer and pulp manufacturer. The harvesting and supply of a significant portion of the total pulpwood consumed is directly under the control of the pulp producer either through in-house or contract logging and transportation activities.

The fact that small diameter, low grade logs are acceptable as pulp furnish results in a wide variety of supply sources from privately owned farmer wood to state-controlled plantation thinnings and subsequent logging operations. Supply sources for significant amounts of this material are often located close to the pulp plant and incurs minimal transportation charges.

Agents participate to a minor degree in sales to the U.S. and overseas markets but are not a major marketing factor. Sales to Japan, Europe or Southeast Asia would undoubtedly have to be negotiated directly with the purchaser. In many cases, the purchaser would also be the pulp producer/distributor and would accept responsibility for arranging transportation and for handling and storage at the port of discharge.

Although both volume and weight are used to determine the contents, and thus the payment for each shipment, in practice, weight is the accepted standard of measurement. Sampling techniques are employed frequently to ensure that the agreed ratio between wood volume and weight is maintained at a reasonably constant level. In other words, although most domestic pulpwood sales are made on a per cord basis, most deliveries (whether road or rail) are weighed and the agreed weight/volume ratio is applied to result in an estimate of wood volume for invoicing.

In effect, the distribution mechanics established for pulpwood trading are very simple and direct. This results not only from the extremely narrow market to be serviced, but also from the low value traditionally attached to pulpwood logs. This low value applies worldwide and has been established primarily to satisfy the requirements of the pulp industry. Since this industry completely dominates the pulpwood market, neither the structure of pulpwood marketing nor the traditional value attached to pulpwood are likely to change.

Transportation Considerations

The restricted nature of world trade in pulpwood has been shown in a preceding section, and one of the major causes of this almost localized distribution pattern is transportation cost. It is probable that transportation costs exert a stronger negative influence on the marketing of pulpwood than on any other forest product. A potential producer of substantial volumes of pulpwood in western Canada would undoubtedly consider market opportunities in the local B.C. and Alberta market, export sales to the U.S. and offshore export sales. Any one of these potential markets possesses the capacity to utilize major volumes of poplar pulpwood.

To secure an adequate share of any of these markets would, however, at the very least, require that the delivered cost of poplar pulpwood be competitive with that of the presently established raw material supplies. In the case of localized sales in B.C. and Alberta, this means competing with softwood pulpwood and with wood residues. In most cases, pulp mills have been strategically located relative to softwood stands and the costs of handling and transporting poplar are at least as high, and often higher than, that for softwoods. Additionally, poplar's relatively high moisture content when felled, plus a rot factor reportedly much higher than softwood, tend to escalate the relative delivered unit cost of usable poplar fibre.

Pulpwood does flow to the U.S. from Canada, but virtually all of this material flows from eastern and central Canada to established users in the U.S. No significant volume of pulpwood is exported to the U.S. from western Canada, and this lack of established trade would present a potential pulpwood producer with the added problem of assembling suitable transportation vehicles. Nearly all pulpwood is carried by specially designed vehicles, and those which are presently in use are usually fully committed and would not likely be available on a long-term basis. An additional factor, which requires careful analysis when evaluating the potential for pulpwood sales to the U.S., would be the under-utilized stands of low quality, small diameter hardwoods scattered throughout the U.S. A reasonable assumption would be that, if a substantial market for western Canadian pulpwood were to develop in the U.S., this market could be supplied more efficiently from U.S.-based hardwood stands.

Virtually all pulpwood used in North America is transported by road and a wide range of transportation costs apply. Farmers and other private land owners supply substantial volumes in both Canada and the U.S. and are normally unaware of the transportation portion of the delivered cost. For commercial transportation, the maximum economical hauling distance is considered to be approximately 200 kilometres, although in some cases, New Brunswick to Maine for example, the average trucking distance exceeds 300 kilometres. However, an average of 80 kilometres in western Canada is considered an acceptable distance.

For overseas sales, recent shipments of sawlogs to Japan and mainland China from west coast ports were subject to transportation costs of approximately $45.00 per cum. This cost included all port, handling and documentation charges. To this must be added inland transportation costs which have been assumed to be based on truck rates of $1.50 and $2.50 per 100 lbs. (45.36 kg), which at present are equivalent to trucking distances of 240 and 400 kilometres. Assuming a green weight of poplar of 800kg per cum inland transportation costs would then amount to approximately $26.00 and $44.00 per cum for the distances assumed. Therefore, assuming a current base selling price of $20.00 per cum for poplar pulpwood (Table 12), the cost delivered to Pacific Rim countries would amount to approximately $91.00 per cum and $109.00 per cum for B.C. and Alberta respectively. As will be shown in a following section, the average cost of aspen/cottonwood landed in Japan from Canada in 1981 amounted to $85.00 per cum. This amounted to twice the cost of aspen pulpwood imported into Japan from the U.S.S.R.

An accurate estimate of transportation costs can only be developed on a site and volume specific basis and, at this point, precise transportation and handling costs are almost impossible to determine. The above estimates are, however, reliable enough to conclude that transportation costs which amount to approximately 200% of base pulpwood cost, constitute the major influence on the ability to market western Canadian poplar pulpwood. This is particularly the case for overseas sales. Therefore, arrangements would have to be made with selected pulp producers to share jointly the costs of transportation before any consideration is given to pulpwood marketing.

Price Relationship

In a preceding sub-section, the statement was made that pulpwood has traditionally been a very low value forest product. Confirmation of this statement is provided by the data, in Table 77, which show the absolute and index values for major forest products on a world basis for selected years commencing in 1960.

TABLE 77 WORLD EXPORT PRICE TRENDS

SAWNWOOD, SAWLOGS, PULPWOOD, WOOD PULP, SELECTED YEARS

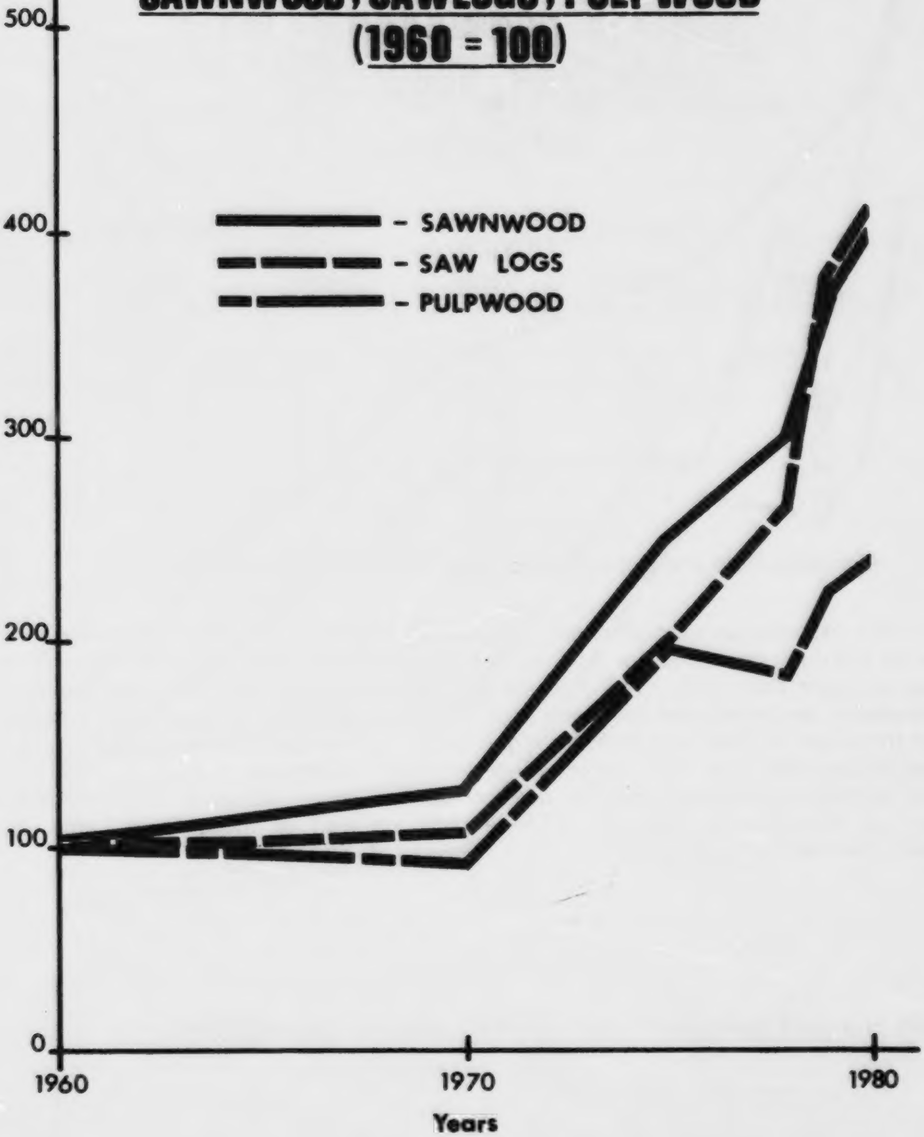
	Sawnwood		Saw Logs		Pulpwood		Wood Pulp
Year	Unit Value	Index	Unit Value	Index	Unit Value	Index	Index
1960	38.0	100	22.5	100	13.7	100	100
1970	46.8	123	23.3	104	12.2	89	128
1975	95.1	250	44.4	197	26.8	196	304
1978	116.7	307	59.7	265	25.3	185	253
1979	143.4	377	88.0	391	27.6	201	299
1980	152.0	400	93.5	416	32.4	236	365

Source: FAO, Yearbook of Forest Products, 1960, 1980.

Despite the inherent imprecision of such broad-based data as shown in Table 77, it is reasonable to conclude that pulpwood price trends have not kept pace with those of the other forest products. Price trends for sawlogs and sawnwood have been reasonably compatible with each other, but those for pulpwood and wood pulp have shown significant divergence, with pulpwood prices lagging well behind those for wood pulp, as further illustrated in Figure 6. The reasons are many and complex, but one is that this relationship reflects the traditional view of pulpwood held by the pulp industry. A second is the impact of low cost wood residue.

FIGURE 6

WORLD EXPORT PRICE TRENDS SAWNWOOD, SAWLOGS, PULPWOOD (1960 = 100)



SOURCE: FAO Yearbook of Forest Products- 1960 , 1980

For Canada, the price pressure exerted on pulpwood by wood residue is illustrated in Table 78.

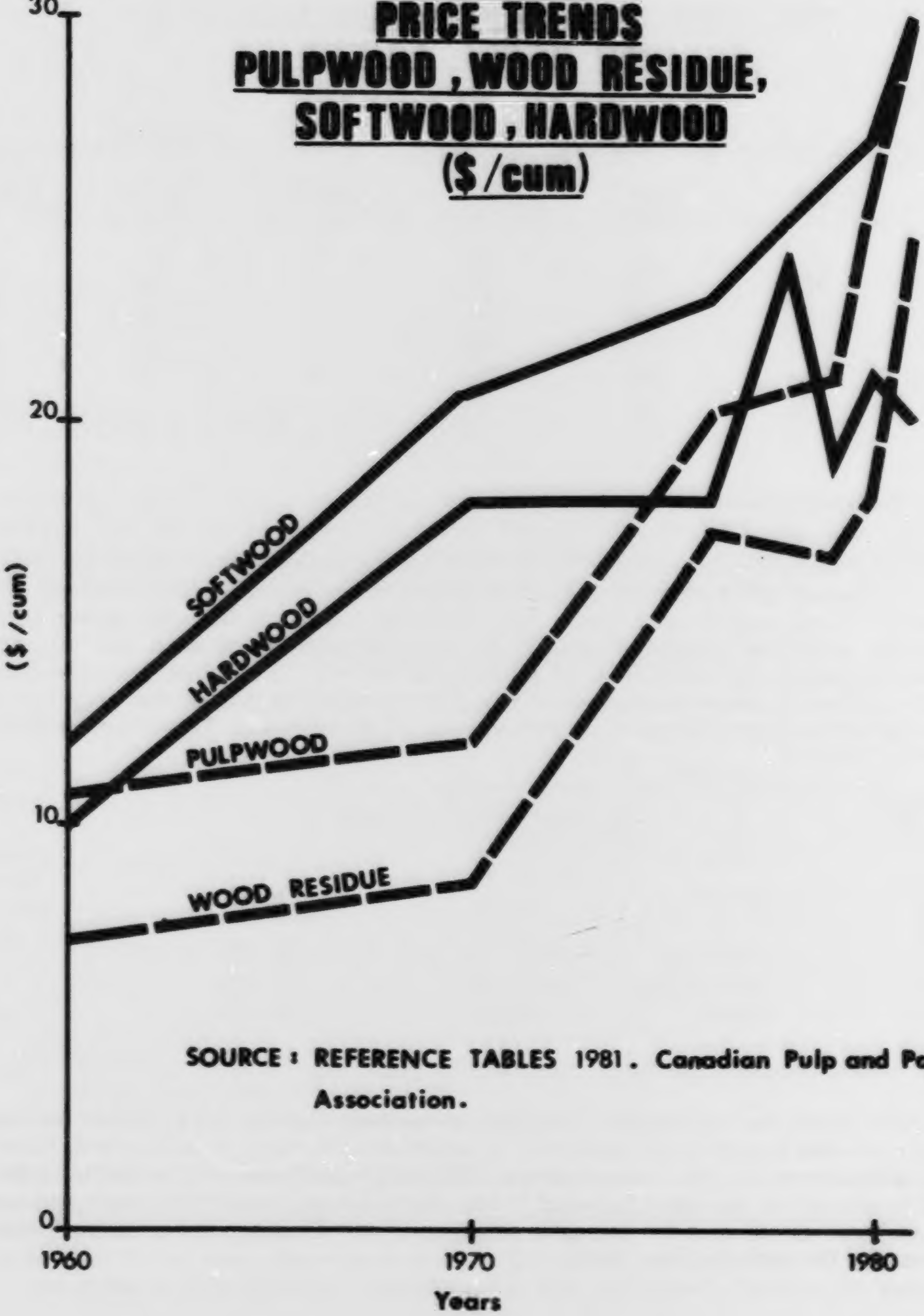
TABLE 78 CANADA
PRICE, VOLUME AND UNIT VALUE PULPWOOD AND WOOD RESIDUE DELIVERED TO PULP MILLS
SELECTED YEARS

	Pulpwood			Wood Residue		
Year	Volume (million cum)	Value (million $)	Unit Value ($per cum)	Volume (million cum)	Value (million $)	Unit Value ($per cum)
1960	34.0	362	10.6	4.3	31	7.2
1970	48.3	582	12.0	17.4	152	8.7
1975	39.5	793	20.1	24.1	411	17.1
1978	43.8	964	22.0	37.6	629	16.7
1979	44.9	1,181	26.3	41.1	744	18.1
1980	40.4	1,07	30.0	41.7	1,021	24.4

Source: Canadian Pulp and Paper Association, Reference Tables, 1981.

The dramatic increase in market share achieved by wood residue is clearly evident. In 1960, wood residue accounted for 11% of total consumption but, by 1980, this share had increased to more than 50%. The reasons for this increased market share are not only that pulpwood's delivered cost has been approximately 25% higher than wood residue, but also that the wood residue cost includes significant wood preparation expenses which must be absorbed by the pulp mill prior to processing roundwood pulpwood. Within the pulpwood segment, softwood species are considered more valuable than hardwood as evidenced by the data in Table 79. These data, as well as those from Table 78, are graphically represented in Figure 7.

FIGURE 7
CANADA
PRICE TRENDS
PULPWOOD, WOOD RESIDUE, SOFTWOOD, HARDWOOD
($/cum)



SOURCE : REFERENCE TABLES 1981. Canadian Pulp and Paper Association.

TABLE 79 CANADA

PRICE TREND, SOFTWOOD AND HARDWOOD PULPWOOD SHIPMENTS, SELECTED YEARS

	Softwood			Hardwood		
Year	Volume (million cum)	Value (million $)	Unit Value ($per cum)	Volume (million cum)	Value (million $)	Unit Value ($per cum)
1970	40	491	12	4	42	10
1975	35	725	21	2	36	18
1976	35	789	23	3	58	18
1977	32	811	25	3	72	24
1978	35	891	26	4	74	19
1979	36	986	27	4	91	22
1980	33	995	30	4	80	20

Source: Statistics Canada

The two most obvious conclusions to be drawn from the data in Table 79 are the stagnant nature of pulpwood utilization and the stable nature of hardwood pulpwood values. These values are not only significantly lower than those for softwood, but also appear to have more-or-less stabilized since the mid-1970's. Similar price trend data are not readily available for poplar, but indications of relative values may be obtained from the current prices for softwood, dense hardwoods and poplar delivered to one of the very few pulp mills in Canada (northern Ontario) presently using all three types. This price relationship is shown in Table 80.

TABLE 80 PULPWOOD PRICE 1982

Species	Range ($per cum)
Softwood	26 - 29
Hardwood	21 - 24
Aspen	18 - 19

Source: Pulp producer, northern Ontario.

Comparable prices are not readily available for western Canada since neither hardwoods nor aspen are used in sufficient quantities to establish a market. It is apparent, however, that all prices have declined sharply since 1980 and, reportedly, are currently at break-even or less in all of Canada. External trade values for pulpwood have been reasonably similar to those established for domestic sales, and Table 81 shows import/export volumes and values for the period 1975 - 1981.

TABLE 81 CANADA
ROUNDWOOD PULPWOOD IMPORTS/EXPORTS

Year	Imports			Exports		
	Volume (thousand cum)	Value (million $)	Unit Value ($per cum)	Volume (thousand cum)	Value (million $)	Unit Value ($per cum)
1975	555	9	16	47	11	12
1976	494	8	16	905	12	13
1977	585	11	18	764	12	16
1978	672	14	21	889	14	16
1979	897	21	23	810	15	19
1980	559	14	25	1,046	26	24
1981	591	17	28	903	25	27

Source: Statistics Canada

Statistical data by which to differentiate between species are not readily available, but it is apparent that the general price trends in trading with the U.S. the only significant pulpwood supply source, are similar to Canadian price trends. Current prices in the U.S., as well as those for other major consuming regions, are shown in Table 82.

TABLE 82 REGIONAL PULPWOOD PRICES, SEPTEMBER, 1982

($per cum)

Region	Price	
	Softwood	Hardwood
Sweden	34.40	32.80
Portugal	18.20	21.13
Germany	52.80	50.60
France	44.95	30.35
Brazil	-	20.40
U.S.	29.50	23.75
Japan	33.96	29.02

Source: European Pulp & Paper Association: Unpublished Data: Japan Lumber Journal, September, 1982.

Note: Prices shown are delivered to the pulp mill in Canadian currency.

The data in Table 82 confirm the conclusion reached previously, i.e., the potential for marketing pulpwood in overseas markets (or in the U.S.) appears to be very limited. Assuming a base price of $20.00 per cum (Table 80), estimates of the delivered price to overseas markets has been shown to amount to $91.00 per cum and $109.00 per cum from B.C. and Alberta respectively. Allowing for the uncertainty related to estimating transportation costs at this stage, it is apparent, nevertheless, that pulpwood from western Canada would be completely uncompetitive in all markets.

Japan is one of the few countries for which delivered costs of aspen/cottonwood are available and, in 1981, the average cost for these species from Canada amounted to $85.00 per cum, compared with $44.00 per cum for aspen pulpwood from the U.S.S.R. This price differential undoubtedly accounts for the fact that imports from the U.S.S.R. amounted to 300,000 cum, compared to 13,000 cum from Canada in 1981.

Similar price differentials exist in all export markets and the possibility of developing a viable industry based on marketing poplar pulpwood appears to be very doubtful.

Trade Inhibitors

Logs (including pulpwood logs) may be freely imported into virtually all world regions. So far as it is possible to determine, there are no countries which impose tariff or quota restrictions on wood in the round. Conversely, almost all countries impose restrictions of varying severity on log exports. For a large number of countries, logs may not be exported under any circumstances and the number of countries which impose a total ban is increasing.

Canada is no exception, and both the federal and provincial governments participate in the regulation of log exports. In general, all goods (including logs) exported require a federal export permit and the federal government can restrict exports by refusing to issue an export permit. In practice, however, unless requested by a provincial government under some emergency condition, such as war, federal export permits are issued as a routine matter. The Forest Act Regulations in Alberta prohibit the export of all logs except Christmas trees and dry pulpwood. Exemption from this restriction may be granted by the Minister of Energy and Natural Resources if the logs are to be used for research purposes. Additionally, export permits may be granted by the minister for a specific volume of logs to be exported and this permit must be renewed every twelve months.

Logs from B.C. may be exported only after the logs have been adequately advertised for sale internally and/or three refusals can be documented from genuine arms-length potential purchasers.

A committee consisting of provincial and federal representatives must examine and either approve or reject all applications for a log export permit. The exceptions to this restriction are privately held timber and some crown timber stands awarded prior to the early 1900's. The volumes represented by these exceptions, however, are relatively insignificant and, for all practical purposes, all logs exported from B.C. must receive the committee's approval, as well as the federal export permit.

Product Modifications

Except for determining quality and size specifications established by potential purchasers, very little can be done to make poplar pulpwood more attractive to the pulp industry. Methods for ensuring minimal moisture content prior to shipment may prove beneficial as regarding transportation costs, but most pulp producers require a fairly high moisture content in the pulp furnish so this factor would also be subject to agreement.

Therefore, other than determining the best size and quality for handling and shipping, product modifications to poplar pulpwood do not appear to be feasible.

Future Demand

Projections of future demand for poplar pulpwood are almost impossible to formulate with a high degree of certainty. The most important variable affecting demand for all pulpwood quality material is, without question, the demand for wood pulp. In the pulp and paper section of this report, the rate-of-increase in future pulp demand has been estimated to amount to 2% annually, world-wide. Logically, the rate of escalation in demand for all types of wood furnish to the pulp industry should also amount to 2% per year. The principal difficulty arises when attempting to predict the share of this increased demand to be taken by roundwood as opposed to wood residue. As previously shown, the utilization of wood residue has been increasing much more rapidly than has that for roundwood. An additional complexity would be estimating hardwood's share of the market and, finally, poplar roundwood's share of the hardwood pulpwood market.

Recent pulpwood regional demand/supply projections, as prepared by SRI, are shown in Table 83.

TABLE 83

PROJECTIONS OF TOTAL PULPWOOD EXPORT/IMPORT BALANCES BY MAJOR REGIONS

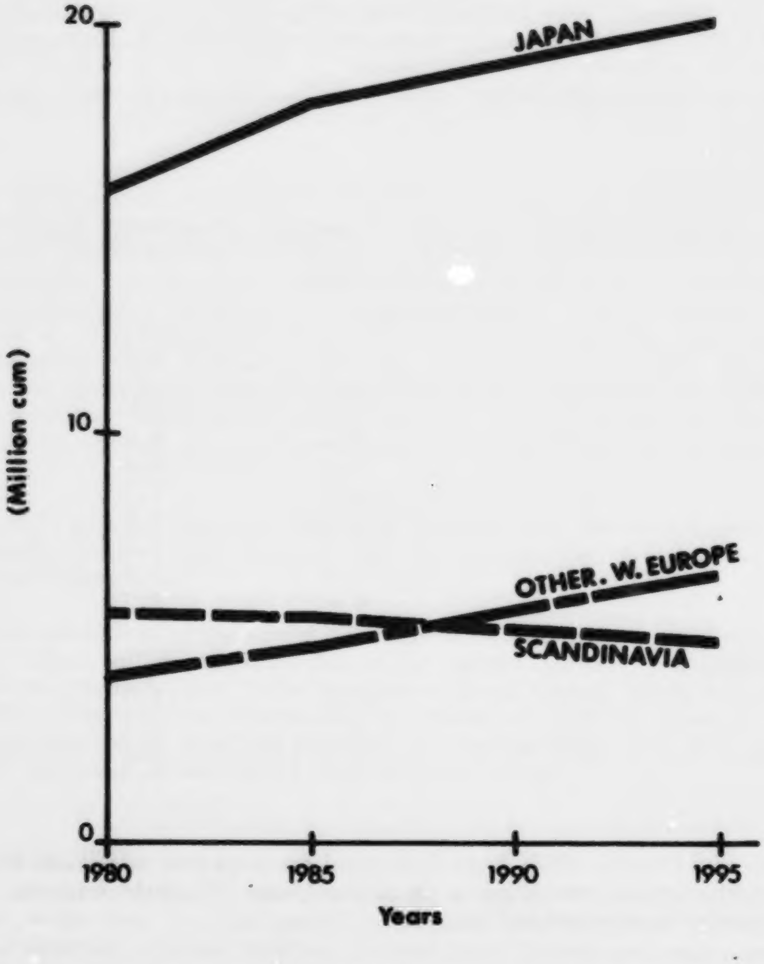
(million cum)

Supply - Net Exports	1980	1985	1990	1995
U.S.	7.8	8.0	8.0	8.0
U.S.S.R.	7.6	8.2	8.6	9.0
Oceania	6.5	6.8	7.3	7.8
Canada	4.7	3.3	2.8	2.3
East Europe	3.0	2.4	1.6	0.8
Africa	1.0	1.8	2.0	2.3
Latin America	-	0.4	2.7	4.4
Demand - Net Imports				
Japan	16.0	18.0	19.0	20.0
Scandinavia	5.5	5.5	5.2	4.9
Other West Europe	3.9	4.9	5.6	6.4

Source: SRI

The U.S., U.S.S.R. and Oceania (90% from Australia) are expected to remain the leading supply regions, with Canada providing a declining share of world imports. Import (demand) is graphically represented in Figure 8.

FIGURE 8
PROJECTIONS OF TOTAL PULPWOOD IMPORTS BY MAJOR REGIONS
(Million cum)



SOURCE : SRI International Forest Products Planning Service. September 1982.

Japan is expected to dominate world imports, although western Europe will account for an increased share of total imports. Projections to 1990 developed by the Japan Paper Association indicate strong growth rates in pulp demand (3.1% annually), combined with increased domestic production of pulpwood (17.0 to 17.34 million cum) and declining imports of pulpwood (16.1 to 15.5 million cum). However, under these projections, an overall imbalance of supply/demand will occur by 1990, resulting in a supply deficit of 1.8 million cum. This, hopefully, will be accommodated by increased domestic production, but most interviewees were very doubtful about this possibility. Despite a fairly extensive plantation program, Japan's forest yield is not expected to increase sufficiently to meet the anticipated shortfall.

Whether or not actual consumption rates will be equivalent to these relative production rates is uncertain. Japan is one of the world's leading users of hardwood pulpwood which represents about 50% of the total furnish consumed in 1980. The Japanese industry is committed to a policy of reducing dependence on high value imported softwood from North America principally by converting to alternate raw materials, including imported and domestic hardwoods. What share of this expected increased demand can be taken by poplar produced in western Canada will depend on many factors. Included in these would be delivered cost, adequacy of supply and adherence to agreed quality standards.

Unquestionably, identical considerations will govern usage of poplar as pulp furnish in all markets. An additional factor which is critical to poplar's acceptance in western Canada, and in the most accessible markets in the U.S., is the adequacy and cost of the established softwood species. At present, there is little or no incentive for any pulp producer in western Canada to introduce poplar into the pulp furnish. On the contrary, it is in the pulp producer's interest to maintain the qualities and grades of pulp presently established in world markets.

Western Europe will continue as a major supply deficit area and, theoretically, should present an excellent market for Canadian pulpwood. In addition to the normal trade constraints of price, quality and adequacy of supply, however, the possibility of increased pulpwood supplies from eastern Europe should be carefully analysed. Such an analysis is beyond the scope of this study, but is considered to be an essential prerequisite to any western-based industrial development.

The U.S.S.R. has been supplying aspen pulp logs to Japan for several years, although the supply has been erratic and in fairly insignificant volumes. The ability of the U.S.S.R. to meet an increased demand for aspen, if market development programs prove successful in Japan, is not known. All interviewees considered the U.S.S.R. as an unreliable, unstable supply source and expressed strong reluctance to increase their dependency on the U.S.S.R. However, as noted in the price section, the cost of aspen delivered to Japan from the U.S.S.R. is approximately half of the cost delivered from North America, and this cost relationship overcomes all other objections to material supplied by the U.S.S.R.

In summary, the development of a significant pulpwood market for western Canadian poplar will depend on the ability of a producer to meet world market prices competitively, to supply an agreed quality of log on a consistent basis and to ensure a consistent supply of an agreed volume. Prior to the establishment of these conditions, however, a considerable degree of market development work would have to be undertaken. Poplar is not well-established in those markets reasonably accessible from western Canada, and securing a significant market share would require extensive and detailed development programs, both technical and commercial. In other words, at the moment, pulp producers see no advantage either in introducing or increasing poplar's share of the overall pulp material furnish.

Conclusions and Recommendations

Producing and marketing poplar pulpwood appears to present an unattractive option for increased utilization of B.C.'s and Alberta's poplar resource. Virtually no local market exists and the further development of the market would require lengthy, complex and costly development programs directed primarily at the pulp production, distribution and utilization system presently established in North America.

For overseas export markets, transportation costs obviously constitute the major obstacle to market development and, unless a joint cost-sharing arrangement could be reached with overseas pulp producers, capturing a meaningful share of these markets would obviously require the acceptance of sales returns lower than the costs of producing pulpwood.

In summary, under present conditions, pulpwood offers one of the least attractive options for processing the poplar resource and should receive a low priority in any development planning.

WOOD CHIPS

Introduction

This section of the report presents an analysis of the domestic and international markets for wood chips. Methods of marketing and distribution are discussed and important technical requirements are briefly summarized.

The information and data presented in this section were obtained from a variety of government and private agencies, previously published reports, and interviews with industry officials. These included producers, agents, shippers and end-users.

A degree of confusion appears to exist in regard to the unit of chip measurement. There are two units used in B.C. The first defines a unit of chips as that volume which occupies 200 cubic feet (5.66 cum) of space regardless of weight, and the second defines a unit as 2,400 pounds (1,088.6 kg) of bone dry wood regardless of space occupied. The international unit is the latter, and the units used throughout this section will be the more or less recognized international standard unit of 2,400 pounds of bone-dry wood (BDU). Where cubic metres of chips are shown, the conversion is based on the generally accepted standard (FAO) that 1 cubic metre of solid wood occupies 2.5 cum of space in the form of chips. Any deviations from these units will be clearly identified.

Product Selection

Wood chips have been used for a variety of purposes including fuel, cattle bedding, particleboard and pulp production, and as garden mulch. As a result of dramatic increases in demand over the past decade or so, however, chip prices have increased to the extent that all end-uses, excepting particleboard and pulp, have become relatively insignificant.

At present, conversion of chips into particleboard is not considered economically feasible in most regions and virtually all chips produced now flow to the pulp industry.

Two principal categories of fibre furnish are used by the pulp industry. The first is long-fibred material (virtually all softwoods) which impart strength to the pulp, and the second is short-fibred furnish which provides "filler" to pulp and is essential for certain types of paper production. Although softwood chips are considered more desirable (hence higher priced) than hardwood chips, nevertheless, as will be shown, the proportion of hardwoods in world pulp production is increasing. This is particularly the case in Japan. Obviously, this trend is of interest to this study and the following analysis includes a discussion of the present and probable future share of the hardwood pulp market accounted for by poplar chips.

Regional Markets

Wood chip production and consumption data are not readily available for all world regions. However, world export data are available and provide a reliable indication of the rate of growth in trade of this product. The data are shown in Table 84 for selected years. World trade prior to 1965 was apparently insignificant and data were not assembled prior to that date, consequently, trend definition is possible only from 1965 onward.

TABLE 84 WORLD WOOD CHIP EXPORTS, SELECTED YEARS

(thousand cum)

	1965	1970	1975	1980
Canada	839	976	522	1,488
U.S.	171	3,510	4,607	6,498
Asia	-	613	906	301
Europe	150	463	684	1,203
Oceania	-	183	2,992	6,999
Central Economies	-	29	236	377
Other	-	-	58	183
World Total	1,160	5,774	10,005	17,049

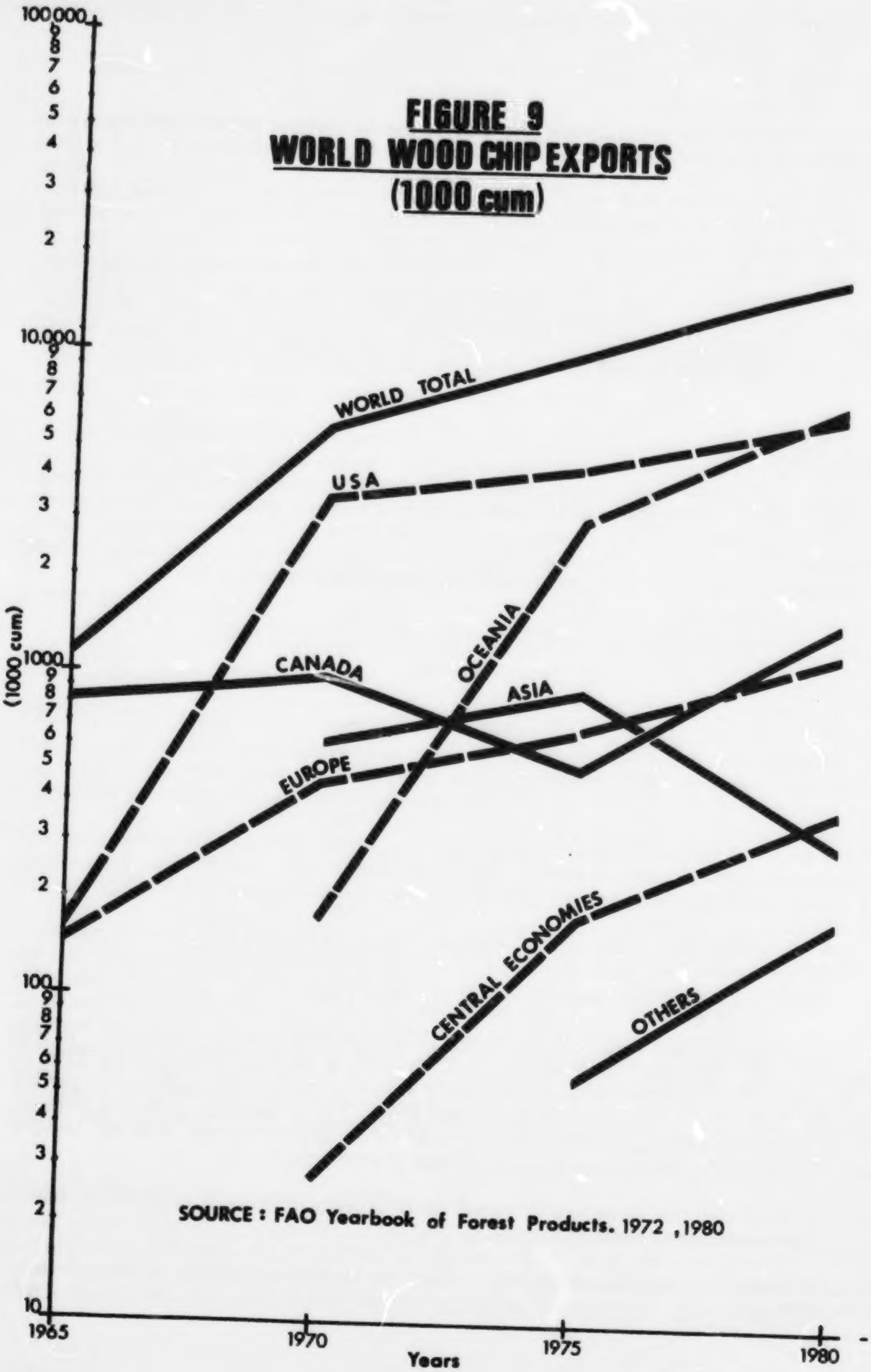
Source: FAO, Yearbook of Forest Products, 1972 and 1980.

The rapidly increasing importance of wood chips in world trade is readily apparent. In the decade 1970-1980, the average annual rate of growth of exports amounted to 12%, a higher rate than that attained by any other major forest product. Although in the period 1965 to 1980 Canada's share of exports declined from 72% to less than 10%, the rate of growth of Canadian exports, nevertheless, amounted to approximately 23% per annum between 1975 and 1980, which is an extremely high growth rate.

In order to illustrate the dynamics of wood chip exports, Figure 9 presents a semi-logarithmic presentation of these statistics.

The flow of chips between source of supply and the consuming regions of the world is shown in Table 85.

FIGURE 9
WORLD WOOD CHIP EXPORTS
(1000 cum)



SOURCE : FAO Yearbook of Forest Products. 1972 ,1980

TABLE 85 DIRECTION OF TRADE, WOOD CHIPS, 1980

(thousand cum)

From	To	Volume	Percent of Total
Australia	Japan	6,561	38
U.S.	Japan	6,004	35
Canada	U.S.	981	6
Canada	Japan	502	3
New Zealand	Japan	373	2
Norway	Sweden	350	2
Malaysia	Japan	301	2
Sweden	Norway	264	1
New Guinea	Japan	193	1
Other	Other	1,520	10
Total Exports		17,049	100

Source: FAO, Yearbook of Forest Products, 1980.

Note: Trends in direction of trade are not readily definable since trade flow data were not assembled prior to 1980. However, except for Japan's imports, most chip trading has traditionally been on an intra-regional basis which is not likely to change.

Japan is obviously the world's dominant import market, accounting for almost 80% of total world imports. The U.S., Australia and Canada are the world's leading supply regions. The major portion of Australia's exports consists of hardwood (eucalyptus) chips, and, conversely, the chips supplied to Japan from the U.S. and Canada consist almost entirely of softwood species, although some alder was also supplied. Malaysia and Papua-New Guinea exported mixed tropical hardwood chips and, as will be shown, Japan's pulp industry is using increasing proportions of hardwoods in the pulp making process.

Of Japan's approximately 23,000 primary wood processing plants, 5,912 produce lumber and chips, while an additional 678 produce chips only. Prior to 1965, chip production in Japan increased at a very modest rate but, from 1965 to the mid-1970's, annual production increased sharply from 8.4 to 16.2 million cum, equivalent to an average rate of approximately 7% per annum. Domestic production apparently peaked in the mid-1970's and stabilized at approximately 16.0 million cum per year. A sharp decline in the sawmilling industry in Japan is reportedly the major reason for the stagnant chip production volume. The proportion of hardwood in the total volume of chips produced has not been identified, but the increasing use of hardwood chips may be deduced from the import data shown in Table 85 and in graph form in Figure 10.

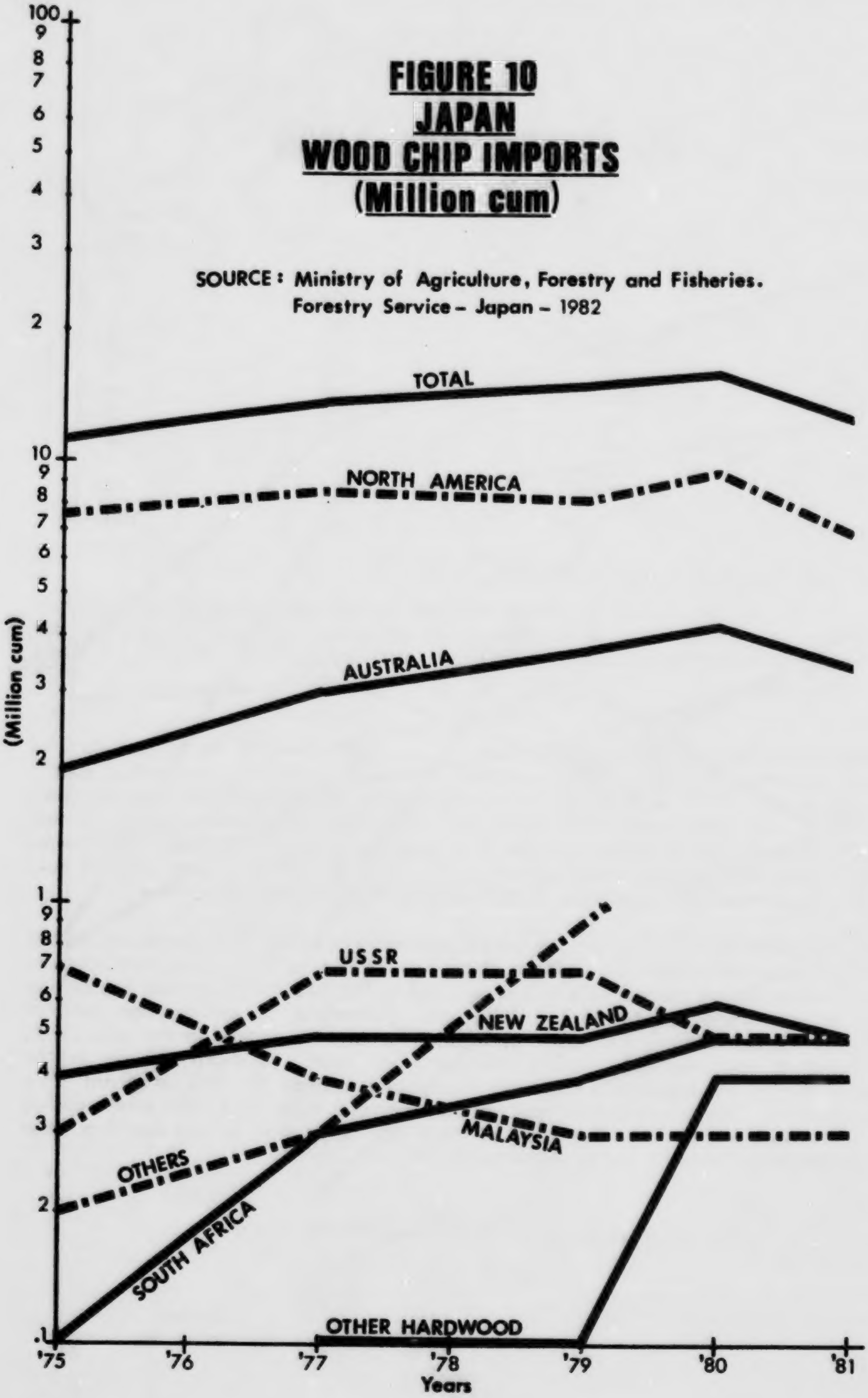


FIGURE 10
JAPAN
WOOD CHIP IMPORTS
(Million cum)

SOURCE : Ministry of Agriculture, Forestry and Fisheries.
Forestry Service – Japan – 1982

TABLE 86

JAPAN
WOOD CHIP IMPORTS, SELECTED YEARS
(million cum)

Supply Region	1975	1977	1979	1980	1981
North America	7.6	8.5	8.4	9.4	6.9
Australia	2.0	3.0	3.7	4.2	3.4
Malaysia	0.7	0.4	0.3	0.3	0.3
U.S.S.R.	0.3	0.7	0.7	0.5	0.5
New Zealand	0.4	0.5	0.5	0.6	0.5
South Africa	0.1	0.3	0.4	0.5	0.5
Other Hardwood	-	0.1	0.1	0.4	0.4
Others	0.2	0.3	0.9	-	-
Total	11.3	13.8	15.0	15.9	12.5

Source: Ministry of Agriculture, Forestry and Fisheries, Japan, Forest Service, 1982.

For the purposes of this study, the assumption is made that all softwood chips are supplied by North America and New Zealand (radiata pine). The remaining areas supply only hardwood chips. On this basis, the proportion of softwood chips declined from approximately 71% in 1975 to 57% in 1981.

A second strong trend in the Japanese pulp industry is the use of increasing proportions of chips (rather than roundwood) of all species in the overall furnish to the pulp mills. This trend is identified in Table 87, and graphically illustrated in comparison with Canada's consumption in Figure 11.

TABLE 87

JAPAN
CONSUMPTION OF PULPWOOD, SELECTED YEARS
(thousand cum)

Year	Total	Roundwood	Chips Volumes	Chips Percent of Total
1960	14,251	10,082	3,978	28
1965	16,613	7,950	8,663	52
1970	28,343	7,277	21,066	75
1976	28,773	3,441	25,331	86
1980	32,727	2,252	30,475	94

Source: Japan, Ministry of Agriculture, Fisheries and Forestry, Forest Service Statistics, 1981.

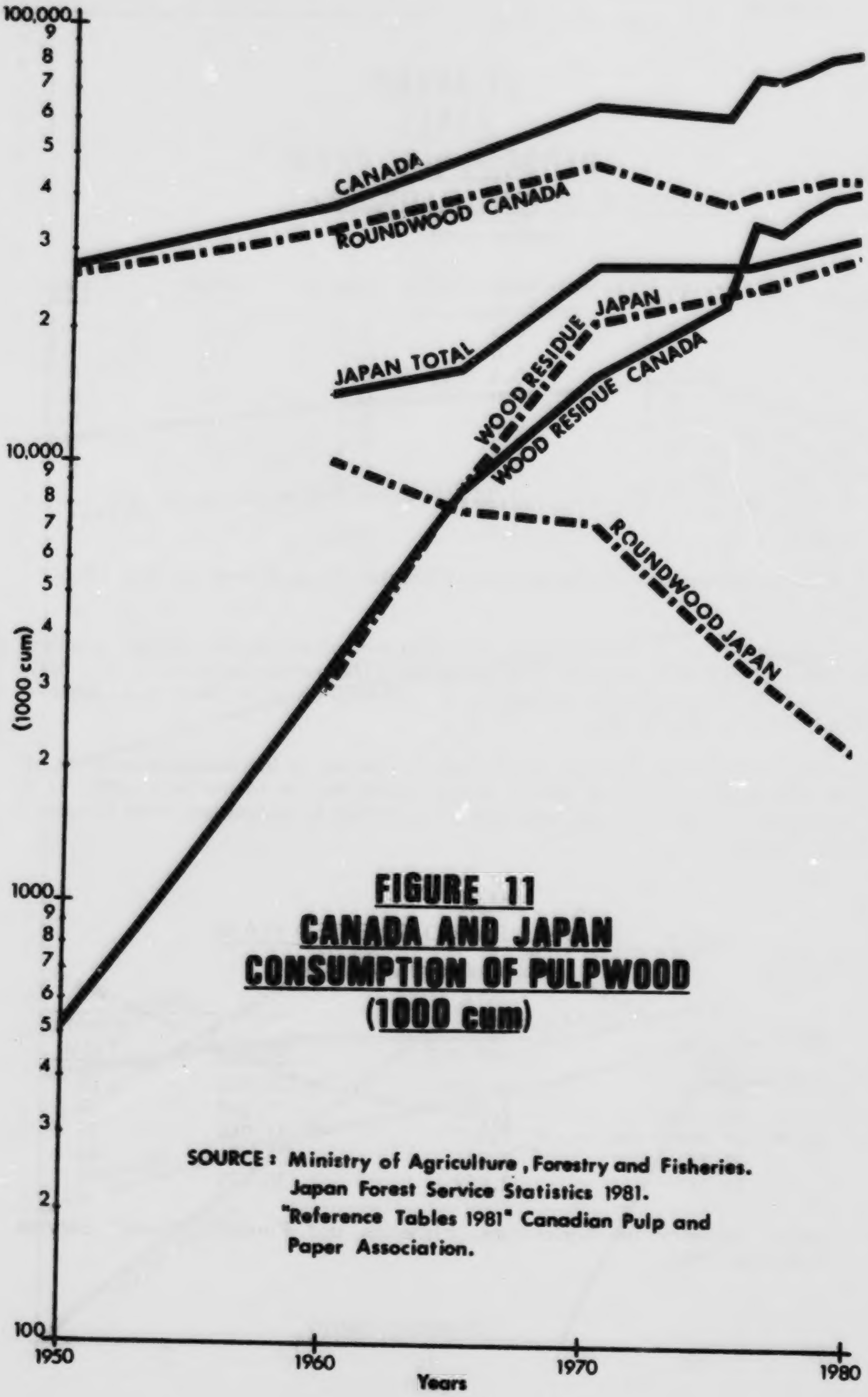


FIGURE 11
CANADA AND JAPAN CONSUMPTION OF PULPWOOD (1000 cum)

SOURCE : Ministry of Agriculture, Forestry and Fisheries.
Japan Forest Service Statistics 1981.
"Reference Tables 1981" Canadian Pulp and
Paper Association.

Although pulp producers appear to have converted almost completely to the purchase of chips rather than roundwood, the degree of conversion is somewhat suspect since data regarding the extent of pulp producers' activities in chip production, other than at the pulp mill site, are not available. In other words, the degree of pulp producers' direct involvement in chip production is uncertain. However, interviews confirmed that the pulp industry does, in fact, now rely very heavily on purchased chips of all species.

In other overseas markets, western Europe imports substantial quantities of chips, but the proportion of hardwood species is minimal, with most of the imports consisting of mixed pine species chips originating, primarily, from the south east region of the U.S. Virtually all other chip trading is between neighbouring European countries, with little inter-regional movement.

Approximately 60% of Korea's pulp requirements are imported and, to reduce this dependency, a program to expand domestic production has been initiated. Korea's timber resource, however, is presently incapable of supporting additional production and, in 1980, Korea commenced importing wood chips. The volume in 1980 amounted to 50,000 cum and increased sharply to 105,000 cum by 1981. Virtually all of this material was imported from Australia and consisted of hardwood (eucalyptus) chips.

Trends in wood chip consumption within Canada are also of interest to this study and are indicated by the data shown in Table 88. For perspective, the consumption of roundwood pulpwood by the pulp industry in Canada is also shown.

TABLE 88

CANADA

ROUNDWOOD AND WOOD RESIDUE CONSUMPTION

IN THE PULP INDUSTRY, SELECTED YEARS

(thousand cum)

Year	Roundwood	Wood Residue	Total
1950	27,521	524	28,045
1960	33,978	4,299	38,276
1970	48,339	17,338	65,727
1975	39,503	24,056	63,559
1976	42,057	34,842	76,899
1977	42,043	33,913	75,956
1978	43,824	37,590	81,404
1979	44,910	41,054	85,964
1980	45,181	41,784	86,965

Source: Canadian Pulp and Paper Association, Reference Tables, 1981.

Note: Wood residue includes chips from sawmills, reject lumber, veneer cores, veneer trim and other woodworking plant waste.

Use of wood residue chips increased rapidly over the period shown. From 1960 to 1970, the average annual rate of increase amounted to 15%, then falling to 9% during the 1970's. Since 1970, roundwood consumption more or less stabilized, consequently, the share of total pulpwood consumption accounted for by wood chips increased from approximately 11% in 1960 to 48% by 1980.

The use of poplar in Canadian pulp production has apparently not increased significantly over the period shown. The data in Table 89 show the use of roundwood by species for 1970 and 1976. Recording of data showing poplar's share of market was apparently discontinued after 1976, and only data showing total hardwood and softwood consumed are readily available to 1980.

TABLE 89

CANADA
SOFTWOOD AND HARDWOOD ROUNDWOOD CONSUMPTION IN PULP PRODUCTION BY SPECIES

(thousand cum)

	1970	1976	1980
Softwood	44,207	38,574	40,934
Hardwood:			
Poplar	1,716	1,182	
Other	2,414	2,300	
Sub-Total	4,130	3,482	4,247
Total Pulpwood	48,337	42,056	45,181

Source: Statistics Canada

The proportion of hardwood in total roundwood used has remained fairly stable at 10%. According to best estimates, the proportion of poplar used has also remained constant. Data showing the quantities of poplar included in wood chip consumption are not available. However, a differentiation between hardwood and softwood chips was maintained by Statistics Canada until 1976 and is shown by province in Table 90.

TABLE 90

CANADA
HARDWOOD AND SOFTWOOD CHIP USE BY PROVINCE
PULP INDUSTRY

(thousand cum)

Province	1970		1976	
	Softwood	Hardwood	Softwood	Hardwood
B.C.	10,390	-	19,050	-
Quebec	2,430	254	6,269	511
Ontario	1,357	268	2,040	290
Other	1,337	18	3,855	253
Total	15,514	540	31,214	1,054

Source: Statistics Canada

The major domestic market for softwood chips is obviously B.C. and, for hardwood chips, it is Quebec. Interviews with industry officials confirm the insignificant use of hardwood chips in both B.C. and Alberta. The reasons are many and complex, but one simple factor is the lack of consistent supply. For all practical purposes, no poplar is processed through sawmills or plywood plants in either province; consequently, economically priced poplar chips are not available.

Not surprisingly, as shown in Table 91, the proportion of chips shipped by province is similar to the proportion of chips used by province.

TABLE 91

CANADA
WOOD CHIP SHIPMENTS BY PROVINCE

(thousand cum)

Province	1979	1980
B.C.	20,064	23,048
Quebec	9,682	10,053
Ontario	4,912	5,232
Others	4,392	4,453
Total	39,050	42,786

Source: Statistics Canada

B.C. and Quebec account for approximately 80% of both chip shipments and chip usage in Canada. Chip exports have become an important element of chip marketing in Canada, increasing from 1.2 million cum to 3.4 million cum in he period 1975-1980. The major portion of these volumes was exported from B.C. In 1981, the export destinations were the U.S., 1.5 million cum (58%), and Japan, 1.13 million cum (42%). In the same year, Canada imported 53,000 cum of chips from the U.S.

The value of all chip shipments increased from $354 million in 1975 to $882 million in 1980 (current dollars), and the value of total chip exports increased from $14 million to $91 million (current) over the same period. On a value basis, therefore, the rate of increase for export sales is more than double the rate of increase for total sales. This results directly from the strong demand from Japan, the world's largest chip importer.

In summary, the major markets for wood chips are North America, Japan, western Europe and, possibly, Korea. For hardwood chips, Japan and Korea appear to offer the best opportunity for development. North American and western European pulp and paper producers have developed a complex, inter-woven system of production and distribution which inhibits major changes in types of pulp produced and, therefore, limits the type or species of wood used.

Undoubtedly, more poplar will be used for pulp furnish in Canada as softwood species become scarcer and more expensive, but all evidence suggests that this would be a long-range development, at least twenty years into the future. For this reason, the Japanese pulp industry, which leads the world in hardwood pulpwood utilization, must be considered the market of greatest opportunity for poplar chip sales from western Canada.

End - Use Market

Wood chips have been used for a variety of end-uses including particleboard, fibreboard, pulp, energy generation, and agricultural uses such as soil stabilizer and animal and poultry bedding. The only significant current uses, however, are particleboard and pulp production. Strong demand pressure over the past decade by the world pulp industry has resulted in sharply increased chip prices which, in turn, makes chips economically unattractive even to the particleboard industry. As a result, more of the alternate and cheaper forms of wood fibre, such as shavings and sawdust, have been used as furnish by the particleboard industry and other traditional chip users. Accordingly, although relatively minor quantities of chips will continue to be used in particleboard* production, the dominant use will continue to be as a pulp furnish. The trends and probable requirements of the pulp industry should form the basis for any additional analysis.

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*"Particleboard" as used here includes all types of fibreboard.

Quality Standards

Various species of poplar have gained a reasonable degree of acceptance as pulp furnish in several industrialized regions, but western Canadian poplars have achieved only minimal acceptance. Many pulping trials have been conducted, some of which proved conclusively that western poplars (aspen in particular) could be used successfully as pulp furnish on a commercial basis. However, the tests also demonstrated that logs must be selected with a reasonable degree of care. Table 92 shows the results of recent trial pulping tests carried out on poplar extracted from stands in Alberta.

TABLE 92

SUITABILITY OF ASPEN AND BALSAM POPLAR FOR WOOD FURNISHED TO PULP PROCESSES

Process	Aspen				Balsam
	Sound Bright	Stained	Incipient Decay	Advanced Decay	Stained
Kraft	Good	Limited	Limited	Very Limited	Limited
Thermo-mechanical (TMP)	Good	Limited	Very Limited	Unsuitable	Limited
Chemi-mechanical (CMP)	Good	Limited	Very Limited	Very Limited	Limited

Source: "Evaluation of the Hardwood Resources of the O'Chiese Block", Alberta Department of Energy and Natural Resources, 1981.

The effect of decay on the suitability of aspen is obvious. The incidence of decay varies considerably between stands, but is much more prevalent in poplar species than in softwoods. It is recognized as a major factor inhibiting utilization of poplar.

Quality standards for fibre furnish are not as demanding in the particleboard industry as in the pulp industry and are, of course, almost non-existent for use in energy generation. As noted, however, the pulp industry offers the best market opportunity for sales of substantial volumes of chips and the requirements of this industry should be accepted as the standard.

Although various systems of chip grading are in use, the "Williams Chip Classification System" provides an acceptable means for evaluating chip quality. Results obtained from recent chipping tests are shown in Table 93.

TABLE 93

RESULTS OF CHIP GRADING TESTS - ALBERTA

		Sound Bright Aspen Roundwood	Stained Aspen	Aspen With Incipient Decay	Aspen With Advanced Decay	Stained Balsam Poplar
Chipping Yield, %		99.9	99.9	99.9	98.2	99.9
Chip Dry Weight, % O.D.		49.3	50.1	54.7	54.3	42.8
Chip Bulk Density						
Uncompacted O.D. lb/cu ft		8.0	8.5	8.2	6.6	8.3
Compacted O.D. lb/cu ft		8.4	9.0	8.5	7.0	8.8
Wood Brightness		69.9	54.2	47.6	31.7	51.0
Chip Classification						
+ 28.6 mm (or 8 mm thick)		8.8	10.5	4.9	9.5	15.9
+ 22.2 mm	%	34.0	28.6	16.8	17.7	31.5
+ 15.9 mm	%	41.0	35.9	35.8	24.5	32.2
+ 9.5 mm	%	13.2	18.2	26.1	27.3	15.8
+ 4.8 mm	%	2.5	5.8	12.4	12.4	4.0
- 4.8 mm	%	0.4	0.7	4.0	3.6	0.6
Bark	%	0.1	0	0	0	0

Source: "Evaluation of the Hardwood Resources of the O'Chiese Block", Alberta Department of Energy & Natural Resources, 1981.

The Williams Chip Classification System which classifies chips by screened sizes is shown in Table 94.

TABLE 94

WILLIAMS CHIP CLASSIFICATION SYSTEM

Screened Size	Percent
+ 28.6 mm	10% maximum
+ 22.2 mm	30% maximum
+ 15.9 mm	30% maximum
+ 9.5 mm	20% maximum
+ 4.8 mm	7% maximum
- 4.8 mm	5% maximum

Source: "Marketing Wood Chips From Alberta Sawmills", Faculty of Agriculture and Forestry, University of Alberta.

It is apparent that, under the Williams Chip Classification System, the results obtained in the test were somewhat erratic, with non-conformity prevalent within the test as well as from test to test. However, chipping techniques could undoubtedly be developed which would permit the production of chip sizes to suit almost any classification system.

As noted, no overall chip size standard exists, but an export standard has been generally agreed upon and is partially reproduced in the following lettered paragraphs taken from a typical supply contract. Poplar is not mentioned specifically but would undoubtedly be categorized in the "Alder" section.

"a) For purposes of the Agreement, "Douglas-fir wood chips", shall mean a quantity which, by volume, BDU basis, contains at least 80% Douglas-fir and east-side Douglas-fir mix wood chips and not more than 20% other coniferous species.

b) For purposes of this Agreement, "alder wood chips" shall mean a quantity which, by volume, BDU basis, contains at least 80% alder wood chips and not more than 17% other hardwood species, and not more then 3% coniferous species.

c) Each vessel load of chips shall, on the average, be substantially free from char and other foreign materials, in keeping with customary industry practice; shall not contain over 2.0% brown rot by bone dry weight nor more then 1.0% bark, by bone dry weight, except alder wood chips shall contain not more than 1.5% bark by bone dry weight. White speck rot shall not be deemed a defect or failure of wood chips to meet specifications.

d) Each vessel load of chips shall on the average be tested for size of chips by Seller's chip analysis procedure described in Exhibit I, attached hereto and made a part hereof, which procedure is based upon sieve analysis procedures conforming to the TAPPI (Technical Association of Pulp and Paper Industry) Standards T-16ts - 61, copy of which is attached hereto and made a part hereof as Exhibit II, or by any other testing procedure which may from time to time be customary in the pulp and paper industry on the west coast of the U.S. to which the parties shall hereinafter agree in writing. The allowable average of all samples tested per vessel load shall contain:

90% minimum of chips from 3/16 inch to 1-1/8 inch in length.
55% minimum of chips from 3/8 inch to 7/8 inch in length.
5% maximum of chips over 1-1/8 inches in length.
5% maximum of fines, sawdust and chips under 3/16 inch in length.

e) Testing procedures set forth in Section 4.1 below shall be used for determining chip quality."

A comparison of the above standards with the test results shown in Table 93 reveals that, with minor discrepancies, all of the wood quality samples used in the test produced acceptable chip sizes and qualitities.

In summary, producing chips of acceptable pulp quality from western poplar should present no extraordinary problem. Similar (or identical) species are already in use worldwide and most major pulp producers are aware of poplar's suitability under certain conditions and for specific end-uses. However, interviews indicated that securing a substantial market share for western poplar chips will depend, to a large degree, on the extent of the development and promotion programs western suppliers are willing to undertake. The concensus found among interviewees was that hardwood chips will undoubtedly account for an increasing share of the pulp market, but that the supplier (or potential supplier), and not the buyer, must assume responsibility for securing a share of market.

Competitive Products

Competitive substitutes for poplar chips are almost any wood species available. Competition in the primary market, pulp manufacture, stems from roundwood of all species, as well as wood chips and agricultural residues.

Trends in residue (principally wood chips) versus roundwood use in pulp production in Canada have already been outlined. To reiterate, however, the use of residue material has increased from 11% of total pulpwood consumed in 1960 to 48% in 1980. A similar trend in Japan has already been described, but of equal importance to a potential supplier of hardwood is the fact that hardwood species accounted for 50% of the total pulpwood consumed in Japan in 1980, as compared with 35% in 1960.

Most of the hardwood pulpwood used in Japan (including chips) consists of high density species. The average density of the eucalyptus imported from Australia, for example, amounts to 960kg per cum and the "wattle" (Acacia) from South Africa has a density of approximately 1025kg per cum. These densities are very high compared to aspen's 370kg per cum and black poplar's 5320kg per cum. The higher density of the tropical hardwoods reportedly results in higher pulp yields and lower transportation costs, since more wood fibre can be transported per unit of space occupied and this is a critical consideration in sea transportation.

In addition to the use of hardwood species in the pulp industry, Japan is one of the leading countries in the world in the utilization of recycled waste paper in pulp production. The opinion was expressed quite often during interviews with industry officials that waste paper would become even more important as a paper and paperboard furnish, and could be considered a major competitive material to wood chips or roundwood. Energy costs in Japan (and all other Southeast Asian countries) have escalated to the point where production of pulp in Japan (or elsewhere) using traditional roundwood or chips is becoming uneconomic relative to imported pulps. Waste paper costs, even after the necessary processing (de-inking primarily), are significantly lower than other furnishes. Increased use of waste paper is considered to be one of the most attractive options open to the Japanese paper and paperboard industry.

The increase in recovery and use of waste paper, as well as the trend in imported material, is shown in Table 95.

TABLE 95

JAPAN
WASTE PAPER RECOVERY AND USE
SELECTED YEARS
(thousand mt)

	Pulp & Paperboard	Waste Paper				
Year	Production	Imports	Exports	Receipts	Net Recovery	Recovery Percent
1960	4,283	27	1	1,492	1,466	34.2
1970	12,260	110	6	4,836	4,733	38.6
1975	13,335	121	39	5,244	5,162	38.7
1980	17,493	224	20	8,283	8,079	46.2

Source: Pulp & Paper Statistics, 1981, Japan Paper Association.

Note: Net recovery = Receipts (at plant) - imports + exports
Recovery percent = ratio of net recovery to paper & paperboard production

Although waste paper will undoubtedly account for an increased share of the paper industry's requirements, technical factors place an upper limit on the proportion of waste paper which may be used in pulp furnish. A discussion of these factors is beyond the scope of this study but, industry officials indicated that with presently available technology, increased use of wastepaper will be undertaken very cautiously and will not occur at a dramatic rate. Chips and roundwood will continue to account for a major portion of pulp furnish for the foreseeable future.

Similar trends are occurring in Korea and Taiwan but, as in Japan, the industry will continue to rely primarily on the traditional raw materials as pulp furnish for the near and medium-term future.

For uses other than pulp production, almost every wood species may be considered a competitor. Poplar chips are technically suitable for conversion into most of the reconstituted wood panels but, unless supplied at competitive prices, would not be used. Experience in the panel industry indicates clearly that, unless chips or other residue of whatever species are generated as by-products of a wood-based manufacturing operation and are used either on the same site or within easy trucking distance, chips can not be utilized economically. In other words, under the correct conditions, poplar chips could be used as successfully as chips of any other hardwood or softwood species.

Distribution Mechanics

Unlike the majority of forest products, neither agents nor distributors participate in the chip distribution process to any great extent. Virtually all domestic contracts are negotiated directly between chip producer and buyer. Overseas export contracts are normally executed between a co-operative shipping organization and overseas buyers.

A major portion of the trade between Canada and the U.S. is on an in-house basis, i.e., producer and user are part of the same company, while most of the remainder of sales is negotiated directly between chip producer and buyer.

The majority of overseas sales from the west coast of North America are channeled through the Weyerhaeuser Corporation in the U.S. and Fiberco Inc. in Canada. Japanese trading companies also purchase directly from suppliers in Alaska and California, but the major supply sources in North America for market chips are Weyerhaeuser and Fiberco. In addition to Fiberco, Johnston Terminals Ltd. of Vancouver also provide storage and ship loading facilities but do not act as sales agents or brokers.

In effect, because both supplier and buyer of chips are so clearly defined and limited in number, the distribution mechanics are much simpler than those established for nearly all other forest products. Even in Japan, in which the number of "middle men" involved in nearly all transactions results in increases of 200% or more over the plant selling price, most chip sales contracts are negotiated directly between producer and buyer. Storage and transportation arrangements are also agreed to directly.

Transportation Considerations

Chips are transported by both road and rail. Except for relatively short hauls in western Canada, the major volume is transported by rail and scows in B.C. and by road in Alberta. The major western Canadian chip flow is from the interior and northern regions of B.C. to the Vancouver area for further shipment to Southeast Asia and Japan.

Regardless of mode of transportation, the degree of compaction, i.e., weight per unit of space occupied, has a major influence on transportation costs. Standard practice on all three rail lines in B.C. (CNR, CPR and BCR) is to charge by the rail car load for material destined for the export market, but by the cubic foot for material shipped to the domestic market.

Charges for all rail shipments are based on a 200 cubic foot (5.66 cum) unit and not on the internationally accepted unit of 2400 pounds* (1088.6kg). To reduce loading/unloading time, however, a flat per rail car rate has been negotiated. This rate has been based on rail car capacities of 6300 and 6600 cubic feet (178.4 and 186.8 cum). However, experience has shown that actual chip volumes per car are in the region of 5500 cubic feet (156 cum) depending on the degree of compaction attained. The effect of the compaction factor, which is to a major degree a function of chip density, on transportation costs may be demonstrated by an actual example.

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*Bone dry weight of chips (BDU).

Recent rail charges for chips transported to Vancouver from 100 Mile House and Fort St. John, B.C. were $938.00 and $1,618.00 per car respectively. Based on a carrying capacity of 6600 cu ft (186.9cum) per car, these charges reflect a cost of $28.00 and $49.00 per unit (200 cu ft or 5.66cum). In actual fact, the maximum chip volumes which could be loaded were only 5400 cu ft (152.9cum) in both cases. Therefore, the true transportation costs per unit* were $35.00 and $60.00, an increase of approximately 25% over the agreed tariff rates.

Transportation by road has been found uneconomic for distances over 200 miles in both B.C. and Alberta. Road transportation charges are based on both the actual weight and volume of the chips carried. In B.C., chip trucks are used for very short distances (maximum 100 km) at an average cost of approximately $20.00 per unit.

Eventually, however, chip transportation charges are based on the weight of fibre expressed in BDU's, regardless of the methods by which inland freight charges are assessed. Both truck and rail cars are weighed in both the empty and loaded condition, and the average moisture content of each shipment is measured. From this data, the actual weight of bone-dry wood fibre is calculated and transportation charges levied accordingly.

Overseas transportation costs are all based on the number of BDU's shipped. A continuous weighing and determination of moisture content is maintained during the loading of the vessel and the number of BDU's per vessel are then agreed upon.

The negative impact of transportation costs on the distribution of a relatively low value, bulky, low density product such as poplar wood chips is severe. A recent study** carried out in Alberta showed that transportation costs ranged as high as 76% of the supplying sawmill's selling price, with deliveries to the pulp mills averaging approximately 50% of the fob sawmill price.

The effect of transportation charges on overseas shipments is even more severe. At present, the selling price for softwood chips in Canada and the U.S. is US$ 98.00/BDU, fob vessel. Transportation costs, from Canada's west coast to Japan, presently average US$ 90.00/BDU which is equivalent to an increase of 92% of the fob vessel price. When unloading and handling charges at the receiving port are added (estimated US$ 15.00/BDU), transportation and handling costs exceed of the fob price by 100%. Since the fob vessel price includes approximately $45.00 to 50.00/BDU for inland transportation, the cost of moving chips to overseas markets at present amounts to approximately three times the sawmill selling price.

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*"Marketing Wood Chips From Alberta Sawmills", University of Alberta.

**"Conversion Factors for the Forest Products Industry in Western Canada". J. Dobie and D.N. Wright. 1975.

The ability to load cargo space with chips efficiently depends, to a major extent, on moisture content and density. The compactability of the chips is a direct function of both factors. Compactability determines the actual volume of chips loaded into the chartered space. In general, therefore, a high chip density and low moisture content are desirable characteristics for transportation, but poplars (particularly aspen) have relatively low densities and a higher average moisture content than most other species, hardwood or softwood. For this reason, many of the interviewees suggested that a program designed to develop methods for compacting poplar chips economically be undertaken as an integral part of any program to improve the production and distribution of poplar chips.

Most of the pulp industry officials interviewed overseas displayed strong interest in the possibility of importing poplar chips. However, as noted, most also believed that the major obstacles to developing a substantial export trade were not technical but economic, and that transportation costs are the major negative factor inhibiting trade. The opinion was also expressed that developing a meaningful chip market was the responsibility of the supplier and not the buyer. In other words, overseas pulp producers have no incentive to utilize poplar under present conditions.

Price Relationships

Mill shipment price data are not available on a world wide basis. No international agency attempts to assemble chip production and shipment data. The proliferation of producing units (sawmills, plywood plants, furniture and cabinet plants and whole log chipping plants) and the relatively minor volumes produced by many of these units make assembly of reliable data almost impossible. Import and export data, however, are recorded and the value of world export shipments does provide a useful measure of regional price trends. Table 96 and Figure 12 show export trends world wide and by major export region commencing with 1965, the first year for which data were published.

TABLE 96

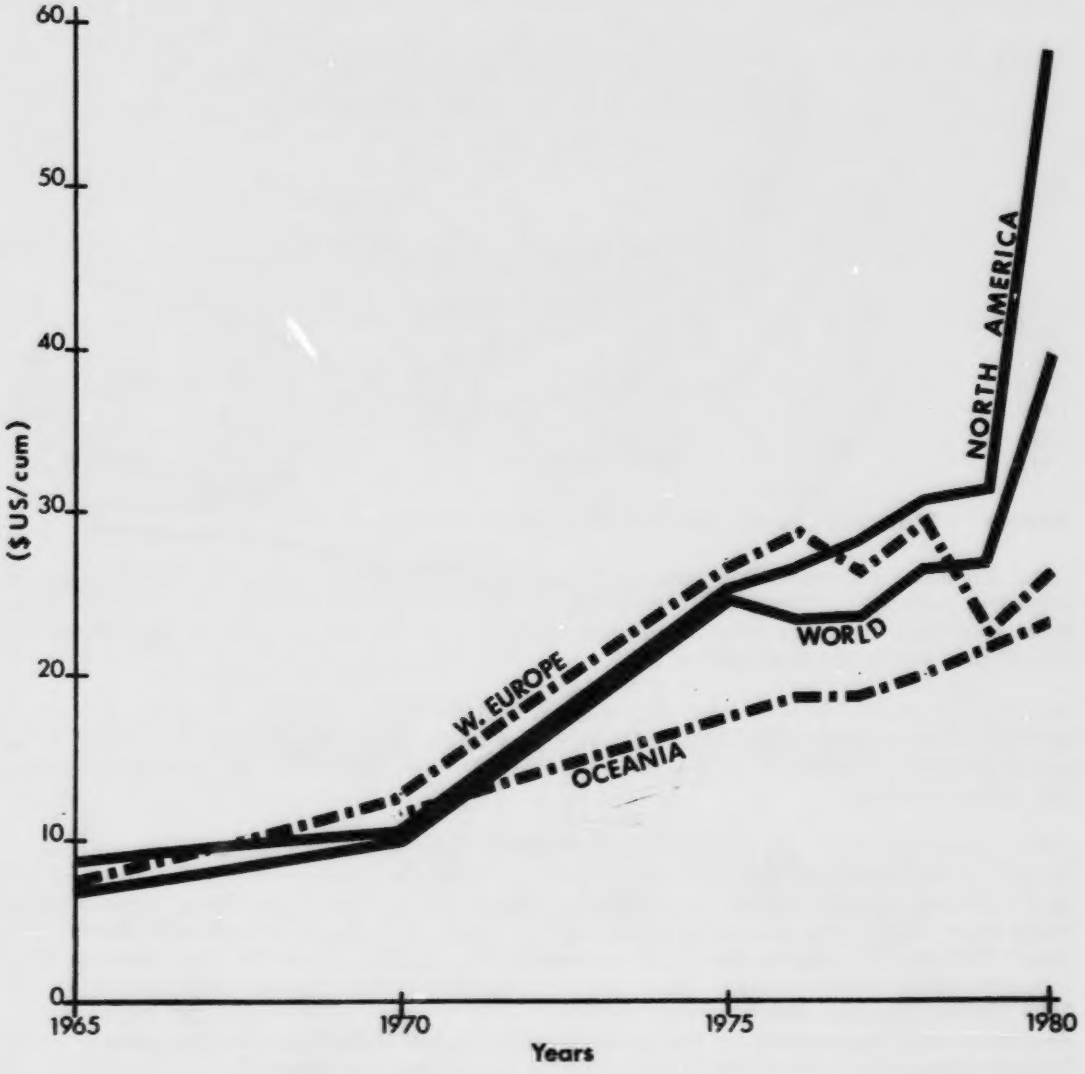
WORLD WOOD CHIP EXPORT PRICE TRENDS - SELECTED YEARS

(US$per cum)

Year	World	N.America	W.Europe	Oceania
1965	6.5	8.3	6.9	-
1970	10.4	10.5	12.2	11.3
1975	24.4	25.3	26.1	24.0
1976	23.2	26.8	28.2	18.4
1977	23.4	28.1	26.0	18.5
1978	25.9	30.9	29.0	20.0
1979	26.5	31.2	22.4	21.5
1980	39.4	57.1	26.1	22.8

Source: FAO, Yearbook of Forest Products, 1972, 1980

FIGURE 12
WORLD WOOD CHIP EXPORT PRICE TRENDS
($ US/cum)



SOURCE : FAO Yearbook of Forest Products. 1972 , 1980

In general, the unit value of world export shipments remained reasonably equal from all regions until 1980, at which point the sales return to North American shippers increased sharply. This price escalation is a direct result of strong demand for softwood chips from the Japanese pulp industry. A sharp differential in sales return realized by Canadian mills from their domestic and export sales is clearly evident from the data in Table 97, which shows the values of wood chip shipments for selected years. This difference is also shown in Figure 13.

TABLE 97 CANADA AND BRITISH COLUMBIA
UNIT VALUE OF WOOD CHIPS SHIPMENTS
($per cum)

Year	Canada		B.C.		
	Total Shipments	Export Shipments	Total Shipments		Export Shipments
			Interior	Coast	
1975	14.7	12.0	11.5	17.4	13.3
1976	14.9	12.0	11.3	16.4	12.1
1977	14.3	15.0	10.6	14.6	15.8
1978	13.7	17.3	9.5	13.8	17.6
1979	15.3	18.1	10.0	17.3	18.3
1980	20.6	27.0	15.6	27.9	28.2
1981	-	29.4	-	-	31.3

Source: Statistics Canada and Council of Forest Industries of B.C.

Total Canadian shipments and shipments from the B.C. interior reflect sales primarily to domestic pulp mills. Since 1980, the differential between the average return from these sales and from overseas sales escalated sharply and reached a peak of approximately $15.00 per cum in the first half of 1981.

Volumes of poplar chips traded in the open market have not been adequate enough to establish reliable indications of price, but poplar chips would probably be classified in the same category as alder chips, which are currently listed approximately 10% below prices for softwood chips.

Chips produced from mixed tropical hardwoods using whole log chipping techniques in Papua - New Guinea are exported exclusively to Japan, and increased in value from $33.00 to $74.00 per cum fob port of shipment over the period 1975 to 1980. Since transportation costs from New Guinea are at least as high as those from North America to Japan, it is clear that this represents the most expensive chip supply source for the Japanese pulp industry. Most interviewees in Japan were of the opinion that the very high density of the New Guinea species, which tended to reduce unit transportation costs and increase pulp recovery, were the reasons for the use of these chips but that, if a lower cost source could be guaranteed, the new source would certainly be seriously considered.

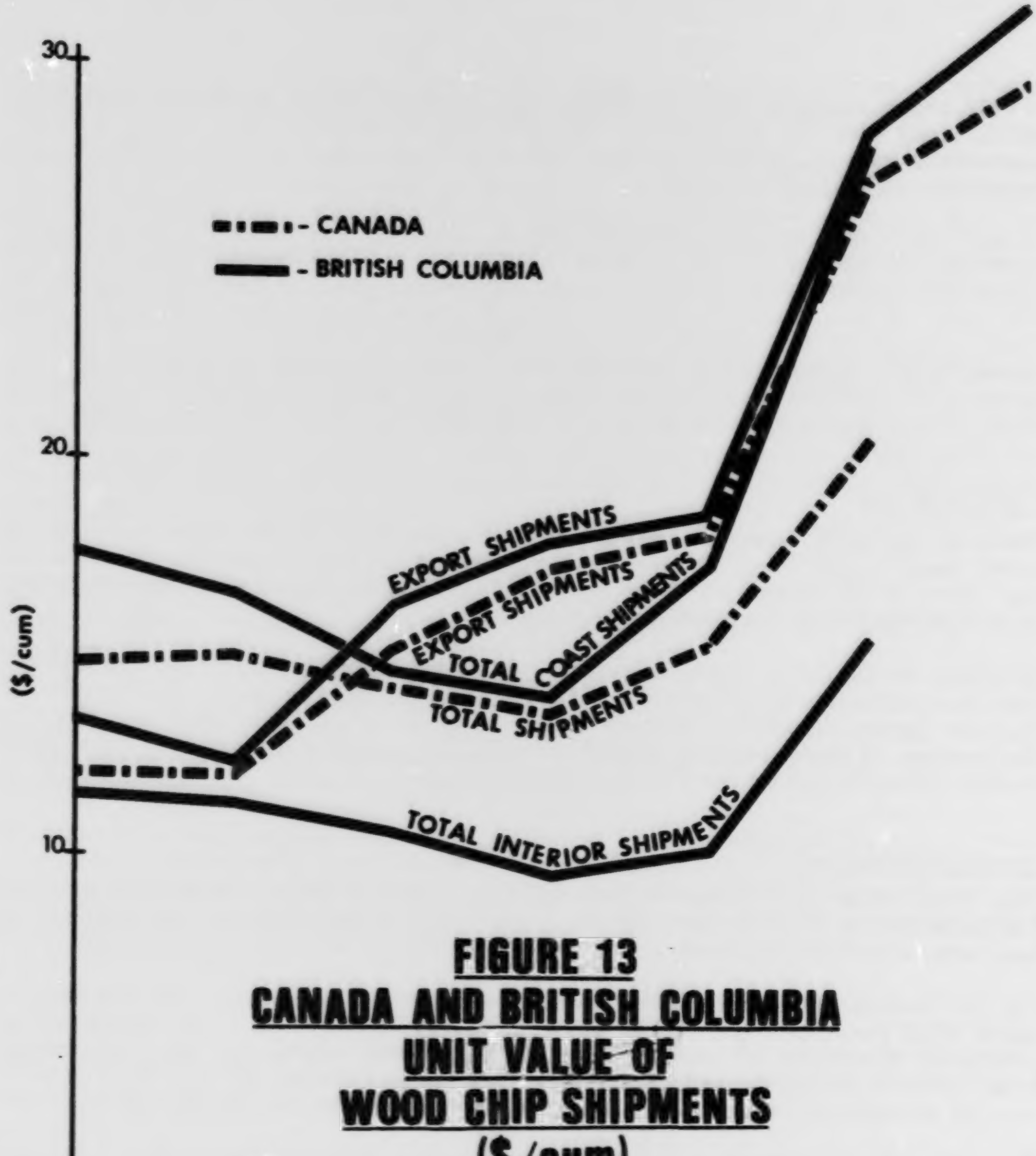


FIGURE 13
CANADA AND BRITISH COLUMBIA
UNIT VALUE OF
WOOD CHIP SHIPMENTS
($/cum)

SOURCE: Statistics Canada Catalogues 35-204, 25-202
and Council of Forest Industries B.C.

In 1982, export prices for chips fell sharply as a result of a decline in demand from Japan which, along with the remainder of the industrialized world, is experiencing a severe economic down-turn. In the first half of 1982, export prices declined from $55.00 per cum to approximately $36.00 per cum.

Undoubtedly, off-shore sales will continue to offer the highest mill return to chip producers, but whether this return would be sufficient to offset inland freight costs from Alberta to a shipping port is uncertain, and the analysis required is beyond the scope of this study. A B.C. location, reasonably close to Prince Rupert, appears to be the most likely site, subject to a detailed analysis. Whether for Alberta or B.C., the analysis should include the potential for reduced costs through use of unit trains which, in turn, requires the production and transportation of substantial volumes of chips on a regular basis. This, of course, requires the prior establishment of a stable and major market.

Trade Inhibitors

There are no tariff, quota or government quality standards in any region which would inhibit trade in wood chips. The trade is very open and, in fact, is more open than that for logs which do not attract tariffs or quotas in the importing country, but are attracting increasing restrictions in exporting countries.

In effect, restrictions to trade in chips consist of the natural inhibitors such as a single market, transportation and handling difficulties and the rigid technical requirements of the sole market. In addition to these general trade inhibitors, poplar chips also face the disadvantage of a low level of market acceptance in what is essentially a commodity market, presently well serviced by established species.

Product Modifications

Very little can be done to improve or beneficially alter the shape or size of poplar chips. The technicalities of producing chips of an acceptable standard are well-established and need only be applied consistently.

For the reasons already discussed, however, methods for compacting the low density poplar chips should be made part of any undertaking which results in the production of substantial quantities of poplar chips. Transportation costs are already a major impediment to successful poplar chip marketing and will almost certainly become even more of an inhibiting influence as energy costs (hence transportation costs) rise.

Discussions regarding the conversion of chips into some form of pulp in western Canada, rather than exporting chips to Japan, were held with several interviewees. Many objections were raised and the concept received very little support. However, because of extraordinarily high energy costs, the Japanese pulp industry is in the process of questioning the validity of its supply/production/distribution system and the consensus appears to be that the industry will become increasingly dependent on imported pulp.

Whether or not western Canada would be regarded as a desirable location to establish additional pulp capacity would depend on satisfying the standard site selection criteria of adequate, technically suitable and economically priced raw material supply, acceptable pulp production costs and competitive transportation costs. A second set of criteria relating to the suitability of poplar-based pulp would also have to be satisfied.

It was made very clear during interviews that Japanese pulp producers consider the responsibility for the development of systems or programs to ensure satisfying the established criteria rests with the potential supplier of raw material and not with the ultimate buyer. Despite this apparent conviction, however, Japanese officials concede that the domestic pulp industry is in a state of transition and is actively searching for alternative pulp supply systems which would result in reducing the current excessively high energy cost portion of pulp produced in Japan.

Therefore, despite the apparent indifference of the interviewees to the suggestion that poplar pulp, rather than poplar chips, be imported from western Canada, serious consideration should be given to developing a proposal for producing poplar pulp in western Canada, primarily for export to Japan. Despite the many obvious obstacles to be overcome, pulp appears to be one of the most attractive systems for converting poplar economically.

Future Demand

Although several variables will influence future demand for wood chips, the most important will undoubtedly be the demand from the pulp industry. Demand projections for pulp are covered in detail in the pulp and paper section of this report but, in summary, world demand is expected to increase at an average rate of 2.1% per annum over the next decade or so. All of the present major producers are expected to retain their relative market shares which means that North America, western Europe and Japan will continue to constitute the major markets for pulp furnish.

A second important variable, which will exert a strong influence over the use of wood chips, will be the availability and cost of roundwood pulpwood. It is considered unlikely, however, that major changes will occur in the present market shares for roundwood and chips. Demand trends for both are expected to parallel those for pulp and an increasing use of chips over roundwood seems likely to continue.

Thus, despite the uncertainties inherent in any demand forecasts, a reasonable assumption is that demand for chips will increase at an average annual rate of approximately 2.1%. In general, the effect of other fibres (mainly agricultural) on the use of wood chips will likely be more than off-set by the increase in fibre demand expected from other end-uses, such as reconstituted wood panel products.

The most critical consideration is not the probable future demand but the degree of acceptance of poplar chips by the pulp industry. In other words, market size is not as important as market acceptance, and broader market acceptance will only be achieved through ensuring adequate supplies of poplar chips on a consistent and economical basis. Currently, neither B.C. nor Alberta have programs or inducements which would attract large volume poplar chip producers to either province. Since the traditional approach of the private sector is to service only established markets, it appears unlikely that poplar chips will become an important forest product in western Canada. An option, however, which does appear feasible, would be the development of a long-term supply agreement with selected overseas pulp producers (Japanese probably) either on a joint-venture or long-term sales contract basis.

Conclusions and Recommendations

Over the past decade, the pulp industry in all world regions has placed increasing reliance on fibre furnish in chip rather than roundwood form. As a consequence, world trade in chips has increased at a higher rate than most other forest products but, with the exception of suppies to Japan, virtually all of this trade has been restricted to trade within regions rather than between regions. The primary cause of this localized distribution system has been transportation costs which, for long distance shipments, account for a disproportionate share of total delivered costs.

To a limited degree, poplar chips are an established furnish for pulp in eastern Canada and in some European countries but acceptance in western Canada and in reasonably accessible markets in the U.S. is virtually nil. The primary reason is reportedly the ready availability of more than adequate supplies of softwood chips produced as by-products of other wood processing systems, primarily sawmills. Western Canadian poplar is technically acceptable as pulp furnish in either chip or roundwood form but the woodworking industry in both Alberta and B.C. processes minimal volumes of poplar on a sporadic basis only. Consequently, low cost by-product poplar chips are not available in significant quantities on a consistent basis. The pulp industry in the west has developed well established, rigid systems of pulp production and distribution which almost preclude the introduction of large volumes of hardwood species such as poplar. For these reasons, ie., abundant supplies of low cost softwood chips and non-acceptability of poplar chips by the western Canadian and U.S. pulp industry, development of poplar chip markets in resource deficient countries such as Japan appears to be the logical option for western Canada.

It is recommended, however, that any development program undertaken be on a highly selective basis and that a secure market be obtained prior to the industrial planning phase. In other words, either joint-venture or enforceable, long-term sales contracts should be ensured before production planning is undertaken. Despite the obvious difficulties and obstacles, both technical and economic, which would have to be addressed, a definite interest in poplar chips does exist in overseas markets and further, more detailed discussions with potential buyers appears to be a desirable extension to this study.

CHEMICALS AND ANIMAL FEED

Introduction

This section of the report deals with chemical products and animal feeds that can be derived from wood in general and poplar wood in particular. Animal feeds are produced from wood in the same manner as other wood-based chemical products but are included under a separate heading.

Because of the complexity of the chemical industry and the hundreds of chemical products that can be produced from wood, only bulk chemicals traded on the world market are extensively treated in the text. For example, methyl and ethyl alcohol are two of the most highly used feedstock chemicals in the petro-chemical industry while, at the same time, they are being developed as sources of energy to replace or supplement gasoline. Research on the production of these alcohols from cellulosic materials has a high priority in the policy of many countries around the world, especially those with no domestic source of petroleum and a surplus of cellulosic waste from farm or forest.

As a preface to the technical description and consideration of chemical and animal feed products derived from wood, some general background on wood chemistry and organic chemistry is necessary for an understanding of the basics of chemical production which, in turn, directly affects the marketability of the chemical.

Organic chemistry is defined as the chemistry of the carbon atom. Organic compounds therefore are those which have been produced primarily through natural animal or plant growth and are composed of increasingly complex molecules based on carbon as the primary building block. Simple organic molecules, i.e., those which contain only carbon and hydrogen, may be found in coal, natural gas and petroleum products (these all having been originally derived from degradation of plant materials) and, in general, are formed of straight chain carbon molecules ranging from methane (C H_4) to extremely long chain molecules designated C_n H (n + 2). By addition of other reactive groups such as OH (Hydroxyl), COOH (carboxyl), CNO (cyano), CHO (aldehyde) and RCO (keytone), aliphatic compounds are formed. Aliphatic refers to straight, open chain compounds - the first major grouping of organic chemicals.

The second major grouping of organic chemicals occurs when a five or six chain carbon compound "closes" to form a ring. In general, this group of chemicals is referred to as the aromatic group and contains (with complex additions) chemicals such as phenols, phenylaldehydes and other aromatic derivatives used in synthesis of a wide range of chemical products.

Wood may be defined as a complex organic polymer composed primarily of carbon, hydrogen, oxygen and some minor amounts of inorganic elements such as nitrogen, sulphur, silicon and halogens.

In general, it is made up of three major organic compounds:

a) Lignin is the primary "adhesive" between wood cells and accounts for between 16 and 30% of the oven dry weight of wood.

b) Hemicelluloses are simple wood sugars and are found primarily in the cell structure of wood and account for between 12 and 30% of the oven dry weight of wood.

c) Cellulose is a complex wood sugar comprising the major portion of the wood cell structure and accounts for approximately 40 to 50% of the oven dry weight of wood.

Lignocellulosic material (wood or plant material) may be broken down from its complex format into simpler compounds of identifiable nature by a variety of processes. The primary processes for this study include hydrolysis, pulping, partial delignification, dehydration, fermentation and pyrolysis. A brief description of the foregoing processes may be found in Appendix 4.

Once wood has been broken down into its main primary components or "building blocks" - cellulose, hemicellulose and lignin - a variety of options exist for the utilization of the resultant products. Simple products such as ethanol, acetone and acetic acid may be produced and used directly, without further modification, as solvents or additives to other industrial compounds or food products. In other instances, once the basic building blocks have been obtained from lignocellulosic material, a series of chemical reactions may be undertaken to further treat the product, resulting in reconstituted complex organic compounds for use in a variety of industries. Some of the additional steps which may then be undertaken for conversion of the simple products include the following: fermentation, dehydration, hydrogenation, isomerization, methylation and polymerization.

Since wood is inherently formed from complex sugars and preprotein materials, some of the primary processes undertaken in the breakdown of lignocellulosic material can result, under controlled conditions, in the production of complex sugars (carbohydrates) and preprotein materials which may be used directly or in incorporated blends for the production of animal and cattle feeds. A simplified listing of those products resulting from primary breakdown, reconstitution or treatment process from wood feedstock may be found in Appendix 5.

The major markets, described in this report, are Canada, the U.S., the EEC and Southeast Asia (Japan, Korea, Taiwan and Singapore). However, because Japan is the only significant trading nation in organic chemicals in Southeast Asia, it is given the most weight in this section. While some statistics have been gathered on a global basis, no consideration has been given to markets other than the above because, for most chemical products, the other markets form a minor proportion of total world trade.

Information and data presented in this section of the study have been derived from a detailed review of technical and trade publications, statistics from government agencies and industry, interviews with research and development personnel, and field interviews with people within the producing and consuming industries for the designated products.

CHEMICALS

Product Selection

The products selected for consideration in this report are those for which there are well developed markets and which have been the subject of extensive research and development using wood as a feedstock. The most important chemicals, such as the alcohols, phenols, butadiene and sweeteners are covered in the text, while the secondary products are described in the appendices. Comprehensive statistics on a global and national basis for most individual chemical products are generally lacking due, in part, to the highly competitive nature of chemical sales and trading, and to the non-disclosure requirements of many statistical agencies.

From Appendix 5, it is apparent that a vast array of chemical products can be derived from wood. This large list of more than 100 compounds originates from the result of only a few processes. The steps in the production of more complex organic compounds from lignocellulosic feedstock involve the full range of organochemical manufacturing. It has therefore been decided that, in order realistically to assess the markets for chemicals and animal feed, the list of chemicals should be restricted to those products readily obtained through primary or secondary breakdown of poplar. The selection has been further refined to those chemicals that have established domestic and world markets and have been traded in volumes large enough to attract consistent data recording.

Table 98 lists the chemicals identified for detailed analysis in the study with respect to market demand and pricing.

TABLE 98 PRIMARY CHEMICALS FOR EVALUATION

Glucose
Xylose
Acetone
Butanol
Xylitol
Furfural
Salicin
Glycerol
Xantham Gums
Lactic Acid
Ethanol
Butylene Glycol
Hydroxy Methyl Furfural
Butadiene
Sorbitol
Low Molecular Weight Phenols
Methylated Phenols
Vanillin
Methanol
Acetic Acid

Technical information and prices for each of these chemicals can be found in Appendix 6.

Regional Markets

The markets for organic chemicals selected for this report are Canada, the U.S., the EEC and Southeast Asia. World statistics on the chemical industry are not assembled by any single agency for all countries, but data are available for regions grouped under the following categories. These categories are referred to in the figures and tables presented in the following pages and a clear understanding of each group is considered important at this point.

EEC:	European Economic Community: Belgium Luxemburg, Denmark, France, Germany, Ireland, Italy, Netherlands and United Kingdom.
EFTA:	European Free Trade Area: Austria, Finland, Ireland, Norway, Portugal, Sweden and Switzerland.
OECD Europe:	Organization of Economic Cooperation and Development, Europe: countries in EEC and in EFTA, plus Greece, Spain and Turkey.
OECD Total:	Organization of Economic Cooperation and Development: countries of OECD Europe, plus Canada, U.S., Japan, Australia and New Zealand.

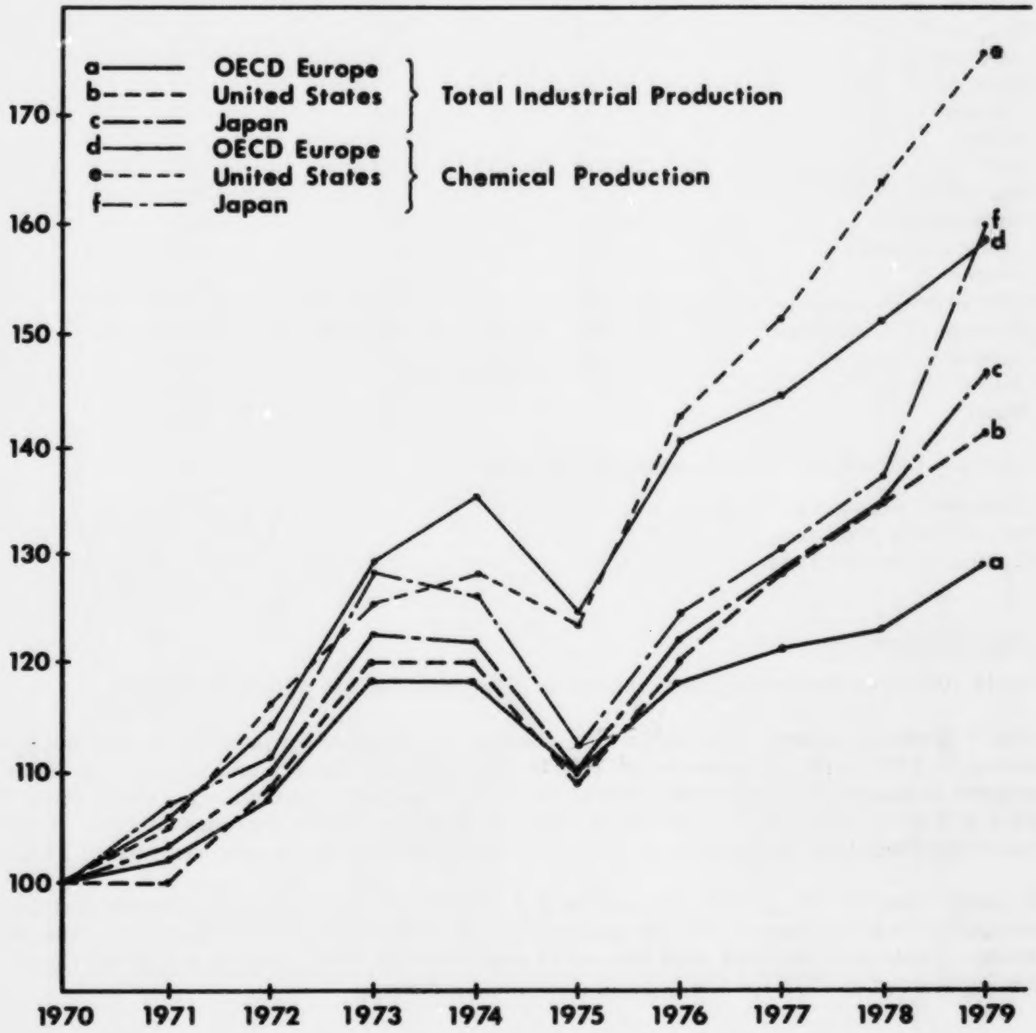
The production of all chemicals has increased dramatically since 1976, after the world-wide economic downturn in 1974-1975. This is illustrated graphically in Figure 14 for OECD Europe, the U.S. and Japan.

Estimated per capita consumption of chemicals also increased dramatically after 1977. Table 99 indicates that average consumption increased by 210% for OECD Europe between 1970 and 1978, while it increased by 216% and 171% for Canada and Japan respectively.

FIGURE 14

INDICES OF PRODUCTION FOR THE EUROPEAN MEMBER COUNTRIES, THE UNITED STATES AND JAPAN

1970 = 100



Source: The Chemical Industry. OECD, 1979

TABLE 99 ESTIMATED PER CAPITA CONSUMPTION OF ALL CHEMICALS IN 1970, 1977, 1978 & 1979

Countries	In U.S. Dollars 1970	1977	1978	1979
Germany	182	487	580	745
Austria	121	528	587	nd
Belgium*	154	454	531	706
Denmark	nd	370	435	nd
Spain	96	284	322	nd
Finland	130	368	398	533
France	141	366	433	nd**
Italy	114	279	337	443
Norway	134	411	381	nd**
Netherlands	172	367	441	nd**
United Kingdom	165	406	465	614
Sweden	174	441	471	nd**
Switzerland	155	nd**	nd**	nd**
Average OECD Europe	143	366***	444***	nd**
Canada	109	382	345	435
United States	227	496	nd**	nd**
Japan	141	nd**	382	nd**

Source: The Chemical Industry, OECD, 1979.

*Excluding man-made fibres.
**nd - no data available.
***Excluding Switzerland.

Organic Chemicals

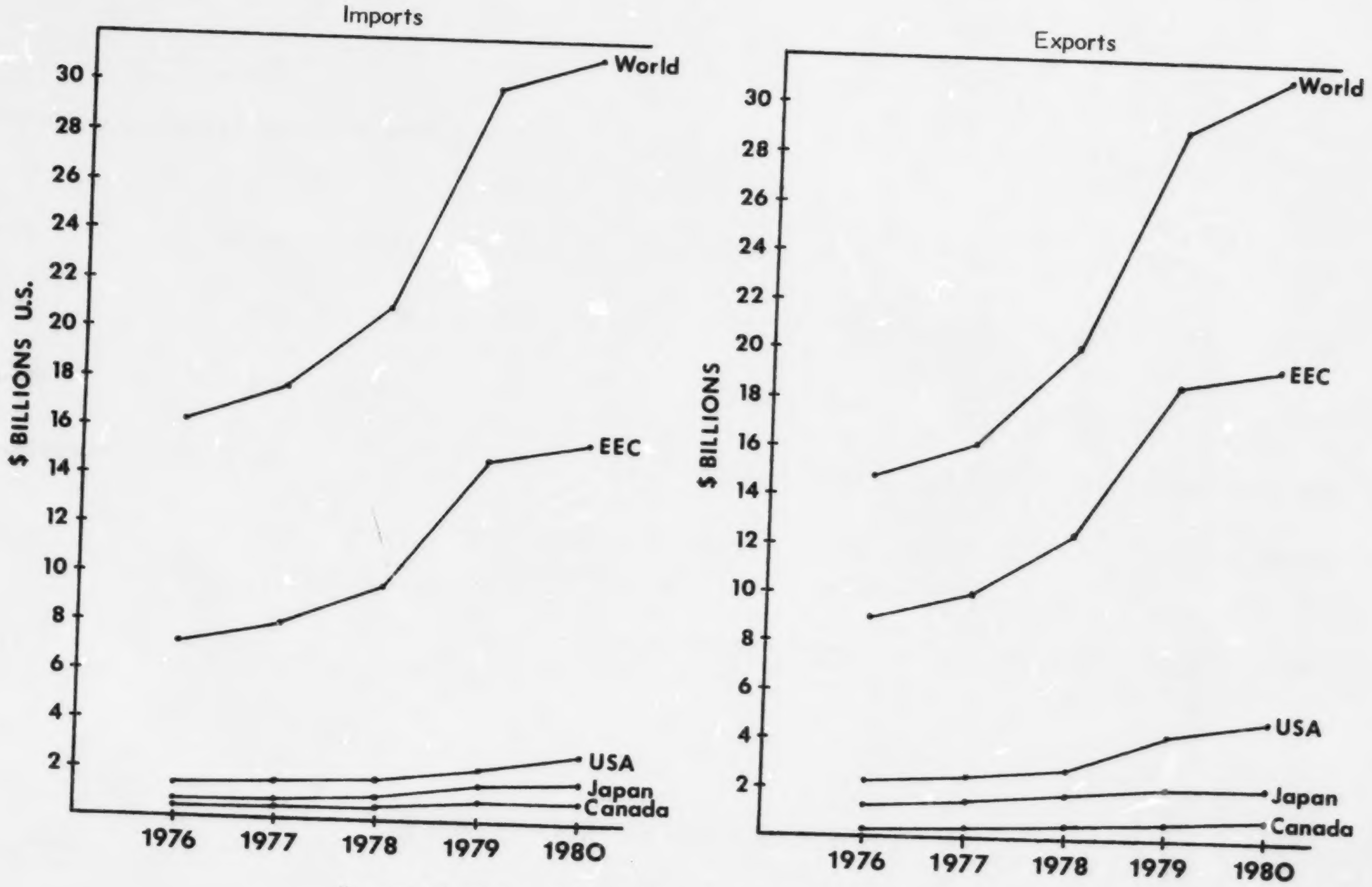
Table 100 shows the world trade in organic chemicals for the period 1976-1980.

World trade in organic chemicals also showed accelerated growth after the economic slump in 1977, with an increase of 51% in the value of imports and 56% in the value of exports between 1978 and 1980. World imports in organic chemicals increased from US$ 16.2 billion in 1976 to 31.7 billion in 1980, an average annual increase of 19%. Exports increased from US$ 14.7 billion to US$ 31.4 billion, an average annual increase of 23%.

A comparison of the growth of imports and exports of the EEC, U.S., Canada and Japan, compared to world figures for the period 1976 to 1980, is shown in Figure 15. The sharp slump in economic activity that the world underwent in 1982 is reflected in the figure as having started in 1979 for the organic chemicals industry.

FIGURE 15

WORLD TRADE IN ORGANIC CHEMICALS



Source: Yearbook of International Trade Statistics, UN 1981

TABLE 100

WORLD TRADE IN ORGANIC CHEMICALS

(m US$)

Country	Imports					Exports				
	1976	1977	1978	1979	1980	1976	1977	1978	1979	1980
EEC	7,243	7,870	9,577	14,666	15,597	9,182	10,098	12,475	18,553	19,468
United States	1,289	1,525	1,640	2,154	2,598	2,226	2,496	2,817	4,388	4,968
Canada	424	466	500	670	698	186	293	391	610	796
Japan	625	668	883	1,464	1,625	1,365	1,567	1,812	2,208	2,270
World	16,199	17,828	20,993	29,883	31,744	14,750	16,214	20,170	29,436	31,387

Source: Yearbook of International Trade Statistics, U.N., 1981.

Alcohol and Phenols

The only readily identifiable group of chemicals in world statistics amongst those selected for this report is the alcohol and phenol group. This important group of organic chemicals forms the feedstock for a host of end products such as plastics and synthetic fibres. The group increased its share of world imports from 12% to 13% of the total for all organic chemicals between 1976 and 1980. Exports of this chemical group remained constant at 12% and amounted to US$ 3.7 billion in 1980.

The major market for alcohols and phenols is the EEC whose imports increased from 42% to 45% of world trade in those commodities between 1976 and 1980. The import share of world trade by the U.S. dropped from 11% to 8% and those by Canada from 2% to 1%. The world share of imports by Japan, however, doubled from 5% to 10% during the same period, showing the increased importance of this chemical group in the overall organic chemical market for that country since world organic chemical imports increased from 4% to 5% only during the same period. World trade in alcohols and phenols is shown in Table 101.

TABLE 101

TRADE IN ALCOHOLS AND PHENOLS

(million $U.S.)

Country	Imports					Exports				
	1976	1977	1978	1979	1980	1976	1977	1978	1979	1980
EEC	819	882	1,000	1,655	1,827	1,161	1,175	1,411	2,189	2,381
United States	205	239	240	257	337	265	292	314	503	619
Canada	42	41	40	50	59	42	66	71	89	129
Japan	99	128	156	279	417	203	230	272	304	282
World	1,951	2,123	2,433	3,533	4,082	1,781	1,899	2,220	3,308	3,712
World Total Organic Chemicals	16,199	17,828	20,993	29,883	31,744	14,750	16,214	20,170	29,436	31,387

Source: Yearbook of International Trade Statistics, U.N., 1981.

EEC

The EEC forms the dominant import market for organic chemical products, with imports of US$ 15,597 million in 1980, comprising 49% of the world total. EEC imports have increased a total of 115% during the five year period 1976-1980, or an average annual rate of 23% (Table 100).

Germany has the largest world share of the organic chemicals trade, with imports and exports of 11% and 20% respectively in 1980. France is the next largest importer with 9%, while Belgium, Luxemburg, the Netherlands, the United Kingdom and Italy each import 7%, and Ireland and Denmark together import 2% of the world's organic chemicals.

German imports and exports amounted to 23% and 32% respectively in 1980. Table 102 shows the details of world trade in organic chemicals within the EEC.

TABLE 102

WORLD TRADE IN ORGANIC CHEMICALS
EUROPEAN ECONOMIC COMMUNITY

(million US$)

Country	Imports					Exports				
	1976	1977	1978	1979	1980	1976	1977	1978	1979	1980
EEC	7,243	7,870	9,577	14,666	15,597	9,182	10,098	12,475	18,553	19,468
Germany	1,766	1,847	2,164	3,325	3,574	3,107	3,514	4,111	6,059	6,195
Belgium-Luxemburg	883	989	1,168	1,963	2,103	1,045	1,144	1,082	1,408	1,469
Netherlands	1,082	1,113	1,249	1,983	2,213	1,957	2,033	2,389	3,874	4,177
France	1,331	1,434	1,777	2,569	2,732	959	1,118	2,039	2,976	3,086
Italy	925	996	1,273	1,990	2,312	716	694	698	1,038	983
United Kingdom	1,033	1,223	1,519	2,168	2,088	1,263	1,451	1,753	2,631	3,020
Ireland & Denmark	223	268	427	668	575	135	144	403	572	538
World	16,199	17,828	20,993	31,744	14,750	16,214	20,170	29,436	31,387	

Source: Yearbook of International Trade Statistics, U.N., 1981.

The world trading flows for alcohols and phenols to and from the EEC for the years 1978 to 1980 show that major trading occurs between the member nations. Seventy-three percent of the imports and 54% of the exports in 1980 are shown to be internal. Imports from the U.S. have increased from 7 to 12% and from Africa from 3 to 4%, while imports from all other nations, including Canada, have decreased slightly.

The major recipient areas for EEC exports are Non-EEC Europe and the Far East.

TABLE 103 DIRECTION OF WORLD TRADE TO AND FROM THE EEC ALCOHOLS, PHENOLS AND DERIVATIVES

IMPORTS (PERCENT)

Year	Japan	Non-EEC Europe	Far East	Africa	Non-OECD America	Canada	U.S.	EEC Europe	Other
1978	2	2	1	3	2	1	7	72	10
1979	2	2	1	3	1	1	9	73	8
1980	1	1	1		1	*	12	73	7

EXPORTS (PERCENT)

Year	Japan	Non-EEC Europe	Far East	Africa	Non-OECD America	Canada	U.S.	EEC Europe	Other
1978	1	10	5	2	3	1	5	51	22
1979	2	12	7	2	3	*	4	55	15
1980	1	11	6	3	3	*	4	54	18

Source: Statistics of Foreign Trade, OECD.

*Insignificant.

U.S.

The import share of world trade for organic chemicals by the U.S. remained constant at 8% during the period 1976 to 1980, while exports increased from 15% to 16%, as may be seen in Table 100.

Imports of alcohols and phenols increased 64% from US$ 205 million in 1976 to US$ 337 million in 1980, while exports increased by 149% to US$ 619 million in the same year as may be seen in Table 101.

The major U.S. markets for alcohols and phenols were EEC Europe with 17%, Non-OECD North America 23% and Japan with 27% in 1980. Exports to Canada from the U.S. have been steadily diminishing from 13% in 1978 to 9% in 1980.

The major sources of U.S. imports of alcohols and phenols are the EEC with 35%, Non-OECD America 26%, Canada 20% and Japan 11%. Imports from the EEC have dropped 5% during the period 1978 to 1980 while they have increased 18% from Non-OECD America and remained constant from Canada.

TABLE 104

DIRECTION OF WORLD TRADE TO AND FROM THE UNITED STATES ALCOHOLS, PHENOLS AND DERIVATIVES

IMPORTS (PERCENT)

Year	EEC Europe	Non-EEC Europe	Far East	Africa	Non-OECD America	Canada	Japan	Other	Total
1978	40	1	5	*	8	20	19	7	100
1979	39	*	5	1	14	21	11	9	100
1980	35	1	3	1	26	20	11	3	100

EXPORTS (PERCENT)

Year	EEC Europe	Non-EEC Europe	Far East	Africa	Non-OECD America	Canada	Japan	U.S.	Total
1978	5	*	7	2	24	13	34	15	100
1979	6	1	9	3	24	10	29	18	100
1980	7	*	13	3	23	9	27	18	100

Source: Statistics of Foreign Trade, OECD.

*Insignificant.

Japan

Japan's import share of world trade for organic chemicals varied between 4% in 1976 to 5% in 1980, rising from US$ 625 million to US$ 1,625 million (see Table 100). Exports for the period increased from US$ 1,365 million to US$ 2,270 million or 66%. The share of the world exports, however, dropped from 9% to 7%. Imports of alcohols and phenols increased by 182% from US$ 99 million to US$ 417 million during this period and, in 1980, amounted to 10% of the world import trade in these commodities (see Table 101). Exports increased by only 39% during the five year period and amounted to 8% of world trade in 1980, making Japan a net importer of US$ 135 million during that year.

The direction of world trade to and from Japan may be seen in Table 105. Japan imports most of its alcohols, phenols and derivatives from the U.S. (35%), the Far East (25%), Non-OECD America (18%), EEC (9%) and Canada (7%). Imports from the EEC have dropped by 4% during the period 1978 to 1980, those from the U.S. rose by 3% and imports from increased Canada by 1%.

In 1978, the bulk of Japan's exports of alcohols, phenols and derivatives (59%) were to the Far East, with another 30% being split about evenly between the EEC, Non-EEC Europe and the U.S.

TABLE 105 DIRECTION OF WORLD TRADE TO AND FROM JAPAN

ALCOHOLS, PHENOLS AND DERIVATIVES

IMPORTS (PERCENT)

Year	EEC Europe	Non-EEC Europe	Non-OECD America	Far East	Africa	Canada	U.S.	Other	Total
1978	13	1	14	25	*	6	32	9	100
1979	12	*	12	25	2	3	39	7	100
1980	9	*	18	25	1	7	35	5	100

EXPORTS (PERCENT)

Year	EEC Europe	Non-EEC Europe	Far East	Africa	Non-OECD America	Canada	U.S.	Other	Total
1978	10	7	65	1	2	*	12	3	100
1979	9	7	69	1	2	*	8	4	100
1980	9	11	59	1	3	*	10	7	100

Source: Statistics of Foreign Trade, OECD.

*Insignificant.

Table 106 lists the imports of all organic chemicals to Japan in 1981. The Japanese chemical industry was forced to reduce production in 1981 because of decreasing exports and stagnant domestic demand. Increasing costs of raw materials and energy made domestic production less competitive with lower cost organic chemical imports which showed a 10% increase over the previous year.

TABLE 106 JAPAN

IMPORTS OF ORGANIC CHEMICALS IN 1981

	Quantity (thousand tonnes)	Value (US$ millions)	1981/1980 (%)
Total	1,643	1,847	110.0
By Country			
U.S.	728	698	108.5
West Germany	55	170	105.6
South Korea	146	99	109.2
Canada	308	96	140.1
Brazil	50	86	116.8
Switzerland	3	80	89.0
China	97	79	120.4
United Kingdom	29	74	98.5
Holland	46	60	124.8
France	26	55	115.2
By Area			
Southeast Asia	204	182	101.6
Western Europe	208	589	110.1
EEC	185	470	115.4
North America	1,036	784	111.5
Central & South America	65	146	116.5

Source: Japan Chemical Annual 1982.

It can be seen that Canada has increased its share of the Japanese market by 140% from 1980 to 1981 and is second only to the U.S. in the trade.

Other Asian Markets

The statistics for other Asian countries are not strictly comparable to the international statistics of the U.N. and OECD. They have been obtained from the individual countries during the overseas marketing phase of the project and, while providing an acceptable indication of the marketing possibilities for Canadian organic chemicals, may not be directly comparable to statistics assembled by OECD.

Korea

The Korean chemical industry at present consists of two petrochemical complexes with a capacity of 505,000 tonnes of ethylene per year. One complex has 20 downstream plants and the other 16. Unlike the U.S. and Canada, which rely on ethane and other low priced natural gases for 70% of their feedstocks, the Korean petrochemical industry employs naptha as its major raw material which reduces its price competitiveness on the international market. Table 107 shows the apparent consumption in Korea for a number of organic chemicals that have been selected as possible derivatives from poplar in this report.

TABLE 107

KOREA
SELECTED STATISTICS FOR SELECTED POTENTIAL POPLAR - BASED CHEMICALS

(thousand tonnes)

Product		1977	1978	1979	1980	1981
Ethylene	Production	87	140	184	373	372
	Import	-	-	1	2	1
	Export	-	-	2	5	-
	App. Cons.	-	-	183	370	373
Butadiene	Production	13	22	26	57	61
	Import	13	17	12	3	4
	Export	-	-	-	5	5
	App. Cons.	26	39	38	55	60
Methanol	Production	261	266	308	209	162
	Import	*	*	*	*	*
	Export	147	136	188	114	61
	App. Cons.	114	130	120	95	101
Acetone	Production	*	*	*	*	8
	Import	7	9	11	7	4
	Export	-	-	-	-	5
	App. Cons.	7	9	11	7	7
Acetic Acid	Production	6	7	7	5	5
	Import	*	*	1	9	13
	Export	-	-	-	-	-
	App. Cons.	6	7	8	14	18

Source: Petrochemical Industry in Korea, 1982.

*Insignificant.

The drop in imports of butadiene and acetone shown in Table 107 resulted from legislation to restrict imports of cheaper feedstocks produced from ethane. Under this legislation, import of petrochemicals is permitted only when the domestic supply price exceeds the CIF price plus a 3% limit.

According to published trade statistics, imports of organic chemicals in Korea have increased from US$ 424 million to US$ 890 million or 109% between 1976 and 1980, while exports increased by 233% from US$ 48 million to US$ 160 million during the same period. Korea is planning to become self-sufficient in organic chemical production, but this will take some time and, in the meantime, the industry is running at only 77% capacity. Production is expected to decline still further unless the restrictions on cheap feedstock chemicals are removed or the industry is reorganized to use coal, biomass or other sources of raw materials.

Hong Kong

Hong Kong imports a large variety of chemicals and exports only minor amounts. Table 108 shows the imports of four major organic chemicals of particular interest in this report.

TABLE 108

HONG KONG
IMPORTS OF SELECTED ORGANIC CHEMICALS
BY COUNTRY OF ORIGIN
January - August 1982

Country	Methanol		Ethanol		Acetone		Acetic Acid	
	Quant. Litre	Value US$	Quant. Litre	Value US$	Quant. kg.	Value US$	Quant. kg.	Value US$
			(thousands)					
U.S.	284	94	1	2	18	31	4	8
Germany/France	1	3	1	4	-	-	85	74
Taiwan	26	12	-	-	-	-	-	-
Singapore	355	255	-	-	39	29	-	-
Netherlands	-	-	-	-	846	535	103	74
U.K.	-	-	6	16	-	-	55	39
China	-	-	16	8	-	-	-	-
South Africa	-	-	124	103	-	-	-	-
Australia	-	-	179	159	-	-	-	-
Japan	-	-	-	-	313	132	-	-
Belgium/Luxemburg	-	-	-	-	-	-	17	13
Total	666	264	327	292	1,216	727	264	208

Source: Hong Kong Trade Statistics, Imports, 1982.

Hong Kong's main trading partners for methanol are Singapore and the U.S.; for ethanol, Australia and South Africa; and for acetone and acetic acid, the Netherlands.

Taiwan

The only organic chemical of significance to this study imported by Taiwan is methanol, and Table 109 provides various statistics related to methanol for the period 1977-1981.

TABLE 109 SELECTED METHANOL STATISTICS FOR TAIWAN

(thousand tonnes)

	1977	1978	1979	1980	1981
Production	117	124	108	110	75
Imports	2	13	38	17	81
Exports	28	10	-	18	3
App. Cons.	91	127	146	109	153

Source: Petrochemical Industries in Taiwan, 1982.

Imports and apparent domestic consumption of methanol have been increasing at a rapid rate for the five year period 1977 to 1981. Domestic production has fallen, probably due to the increased cost of feedstock from domestic refineries which use petroleum, and lower prices for imported methanol derived from natural gas produced in Canada and the U.S.

Taiwan has a rapidly growing petrochemical industry with a rated ethylene capacity of 634,000 tonnes in 1981, which makes it the 12th largest producer in the free world.

The presently depressed world economy and increased interest rates have forced the government to lift import restrictions on cheaper imports of feedstock, as the high prices of the domestic oil-based refineries would have forced the petrochemical industry out of business. Taiwan produces a small amount of natural gas and oil, but imports 99.2% of its requirements for oil.

Singapore

According to "Petrochemical Industries in Taiwan" imports of organic chemicals into Singapore in 1980 totalled US$ 172 million, an increase of 129% during the period 1976 to 1980, while exports rose 200% to US$ 91 million during the same period. Imports of alcohols and phenols amounted to US$ 34 million in 1980, an increase of 143% since 1976, and comprised 28% of total imports of organic chemicals. Statistics on imports and exports for the period 1976 to 1980 are only available in U.S. dollars, otherwise more meaningfull volume data would have been used.

Singapore's imports of selected chemicals for the first 8 months of 1982 are shown by country of origin in Table 110.

TABLE 110

SINGAPORE
IMPORTS OF SELECTED CHEMICALS
BY COUNTRY OF ORIGIN

(January - August 1982)*

Country	Methanol		Ethanol		Butanols		Acetic Acid		Acetone	
	Litres	US$	Litres	US$	Litres	US$	Litres	US$	Litres	US$
				(thousands)						
Canada	11,504	2,096								
Germany	7	25	19	45	441	220	25	36		
Malaysia	1,571	328	7	8			30	83		
U.K.	607	328	32	25	13	12				
U.S.	25,208	5,307			1,047	569	979	423	321	212
France				13	12	13	8			
Japan			15	8	13	13	495	217	2,163	1,201
Netherlands					17	17	62	52	1,113	648
Norway				7	8					
Taiwan				13	11	76	48			
Australia			119	85					2	8
Belgium/Luxemburg						74	46			
China						330	226			
Mozambique									450	239
Other			10	13					3	8
Total	38,897	8,084	122	221	1,565	862	2,106	1,162	4,051	2,316

Source: Singapore Trade Statistics, August 1982.

*Only information available.

Imports of these five products during the period January to August 1982, had a value of US$ 12.6 million, comprising 7% of the total value of imports of organic chemical products to Singapore. The imports were mainly from the U.S., Japan and Germany. Canada, however, provided one third of total methanol imports.

Singapore is the third largest refining centre in the world. The petrochemical industry is large, and has a US$ one billion complex coming on stream. Only tentative conclusions can be reached from Table 110, given the short time span of the available information. However, it does indicate the large quantities of organic chemicals being imported and, taken with the large scale of petrochemical activity under way, it indicates that Singapore is developing into a major market.

Canada

Domestically, Canada provided 2% of the world trade in organic chemicals and 3% of the exports in 1980, ranking 8th in imports and 9th in exports. Canada's imports in 1976 amounted to US$ 424 million, which by 1980 had increased 65% to US$ 698 million. Exports increased from US$ 186 million to US$ 796 million, an increase of 328% during the same period. (See Table 100.)

Exports of alcohols and phenols have increased by 207% during the period 1976-1980 to US$ 129 million, amounting to 16% of total Canadian exports of organic chemicals. (See Table 101.)

The direction of trade to and from Canada in alcohols and phenols is shown in Table 111, which indicates that over 85% of the imports are supplied by the U.S., followed by the EEC and Japan. In like manner, most of the exports go to the U.S., followed by Japan and the EEC. It is interesting to note that the exports to Japan have almost doubled between 1978 and 1980.

TABLE 111

CANADA
DIRECTION OF WORLD TRADE
ALCOHOLS, PHENOLS AND DERIVATIVES

IMPORTS

(%)

Year	EEC Europe	Non-EEC Europe	Far East	Non-OECD America	Africa	U.S.	Japan	Other	Total
1978	26	*	1	1	-	70	*	2	100
1979	10	*	*	*	-	87	1	2	100
1980	11	-	1	*	1	86	1	1	100

EXPORTS

(%)

Year	EEC Europe	Non-EEC Europe	Far East	Non-OECD America	Africa	U.S.	Japan	Other	Total
1978	18	-	5	6	2	60	9	*	100
1979	17	2	3	5	*	59	7	7	100
1980	14	2	3	3	*	54	19	5	100

Source: Statistics of Foreign Trade, OECD.

*Insignificant

There are 40 oil refineries in Canada, of which 7 are in Alberta and 7 in B.C., placing approximately 19% of the total capacity in western Canada.

The Canadian petrochemical industry is highly developed with 69 petrochemical plants, of which 11 are in Alberta and 7 in B.C. Seven of the Canadian plants use methanol as a feedstock, of which one is in Alberta and two are in B.C. A new plant in B.C. has a capacity of 400,000 tonnes of methanol per year using a feedstock of natural gas. In Quebec, a plant using ethylene as feedstock has a productive capacity of 70,000 tonnes of ethyl alcohol per year. Appendix 7 contains a listing of currently installed petrochemical plants, which use petroleum products or natural gas as feedstock, with their capacities and products.

Some of these refineries produce chemicals that would be in direct competition with those that can be derived from poplar. A partial list of such products and present capacity in Canada is shown below:

Butadiene	-	452,000	tonnes per annum,
Xylene	-	494,900	cubic metres per annum,
Methanol		11,000,000	tonnes per annum,
Ethanol	-	70,000	tonnes per annum,
Acetic Acid	-	72,575	tonnes per annum.

These figures are presented as background to demonstrate the magnitude of the petrochemical industry as a major competitive source to the chemicals which could be derived from poplar.

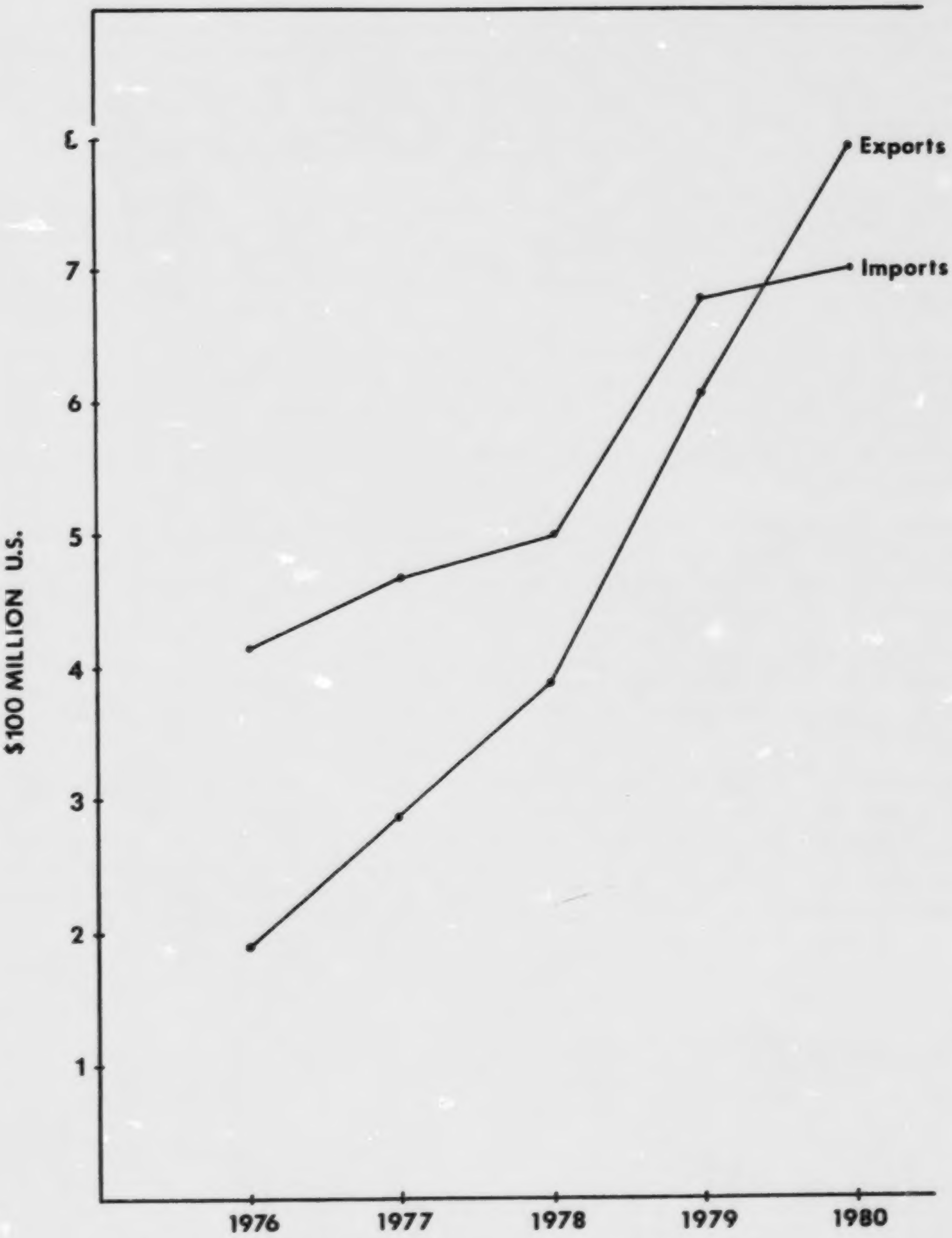
Apparent consumption trends are almost impossible to identify specifically because production figures for most groups are not published by Statistics Canada to protect the interests of the small number of refineries producing each group. In addition, import and export statistics are not compiled in a standard format, making valid comparisons almost impossible.

Canada's exports of organic chemicals exceeded imports for the first time in 1980. As shown in Figure 16, both imports and exports showed rapid growth during the years 1978 to 1979, about 34% and 56% respectively. However, the down turn in 1979 affected only imports and reduced the growth rate to 4% while exports grew at a rate of 30% until 1980.

FIGURE 16

CANADIAN IMPORTS AND EXPORTS OF ORGANIC CHEMICALS

1976 - 1980



Source: Yearbook of International Trade Statistics, UN, 1981

Canadian Market - Selected Chemicals

The tremendous number of carbon compounds that can be derived from petroleum, natural gas, coal or wood and that are used as feedstock for manufacture of chemical products, make it difficult to generalize about markets. For this reason, a short list of chemicals derived by primary processes from wood, that are commonly used as feedstock for further manufacture have been selected for detailed description in this report. However, as has been previously mentioned, available statistics are limited for specific chemicals.

Table 112 lists ten chemicals of particular interest and records Canadian import statistics by volume and value for the period 1972 to 1981. In addition to these chemicals, Appendix 8 contains Canadian import and export statistics for the period 1972-1981 for a broad range of chemical products which could also conceivably be produced from poplar as the feedstock.

It can be seen from Table 112 that imports of alcohols and derivatives, methyl alcohol and butyl alcohol have substantially decreased over the ten year period, which indicates that the domestic industry is now able to satisfy the domestic market.

Imports of ethyl alcohol are almost negligible as Canadian capacity is about twice the volume of demand.

Imports of butadiene have varied over the years but have been dropping since 1979 as local industry supplies the demand. Polysar has a butyl rubber plant in Sarnia with a capacity of 45.8 thousand tonnes per year and is building a new $250 million plant which will have 963.5 thousand tonnes annual capacity.

The market for acetic acid expanded in Canada in 1979 and imports have increased from 15,000 tonnes to 18,000 tonnes in the three years to 1981. Vanillin has a small Canadian market which is well supplied by one Canadian producer using pulpmill effluent as the basic feedstock.

The market for benzoic acid has expanded in Canada since 1972, with imports increasing 119% from 468 tonnes to 1,025 tonnes with a value of $2,329,000, in 1981. Imports of xanthates began in 1973 and have increased by 378% from 514 to 2,455 tonnes, with a value of $3,151,000, during the 9 year period. The importation of glucose syrup has only been separately specified in the statistics since 1979 when 11,000 tons were imported. Imports increased to 41,000 tonnes in 1980 and dropped back to 13,000 tons in 1981.

TABLE 112

CANADA
IMPORTS OF SELECTED CHEMICALS

Imports/Chemicals

	1972			1975			1976			1977		
	tonnes	$(000)	$/t	tonnes	$(000)	$/t	tonnes	$(000)	$/t	tonnes	$(000)	$/t
Alcohols and Derivatives	23,656	4,599	194	19,872	10,106	509	26,211	13,179	503	25,612	16,178	632
Ethanol	-	-	-	-	-	-	-	-	-	20	27	1,350
Methyl Alcohol	103,028	3,155	30	21,477	2,123	99	7,373	701	95	10,288	939	91
Butyl Alcohol, Normal	3,715	588	158	1,008	492	478	648	280	423	264	131	496
Butadiene	2,914	514	176	15,108	5,985	396	23,593	9,089	385	37,131	16,348	440
Acetic Acid	-	-	-	-	-	-	-	-	-	-	-	-
Vanillin	36	223	6,194	15	223	14,867	22	279	12,682	145	223	1,538
Benzoic Acid	468	295	630	1,153	1,240	1,075	1,284	1,260	981	1,141	1,557	1,365
Xanthates	-	-	-	738	659	893	550	550	1,000	831	824	992
Glucose Syrup, Food Grade	-	-	-	-	-	-	-	-	-	-	-	-

Imports/Chemicals

	1978			1979			1980			1981		
	tonnes	$(000)	$/t	tonnes	$(000)	$/t	tonnes	$(000)	$/t	tonnes	$(000)	$/t
Alcohols and Derivatives	22,506	15,045	668	7,998	9,904	1,238	6,532	10,832	1,658	8,085	11,188	1,384
Ethanol	23	24	1,043	135	130	963	228	206	990	476	405	851
Methyl Alcohol	11,704	1,471	126	709	100	141	558	163	292	859	208	242
Butyl Alcohol, Normal	292	149	510	266	146	549	209	127	608	355	248	699
Butadiene	23,285	11,337	487	27,023	15,529	575	19,123	13,922	729	15,595	10,517	674
Acetic Acid	-	-	-	14,970	12,503	835	14,148	14,101	997	15,868	18,016	1,135
Vanillin	11	193	17,595	7	100	14,286	11	201	18,273	10	122	12,200
Benzoic Acid	983	1,533	1,560	1,042	1,740	1,670	968	1,975	2,040	1,025	2,387	2,329
Xanthates	628	688	1,096	954	1,050	1,101	2,121	2,528	1,192	2,455	3,151	1,286
Glucose Syrup, Food Grade	-	-	-	11,208	3,415	310	41,367	15,252	369	28,203	13,121	465

Source: Statistics Canada

Major Chemical Markets

Alcohols

World trade in alcohols of all types is second, in terms of dollar value of organic chemicals, next to crude petroleum. World trade statistics for alcohols of all types have already been shown in Table 101 for the years 1976 to 1980. It can be seen from this table that, in 1980, Canada imported alcohols of all types with a total value of US$ 59 million, and exported alcohols with a value of US$ 129 million.

Methanol

The supply and demand estimates prepared by the World Bank for methanol for 1979 and 1983 are shown in Table 113.

A list of the alcohols imported into Canada during the period 1977 to 1981 by volume and price per ton is shown in Appendix 8. Exports of alcohols are not differentiated by Statistics Canada. However, the totals are shown by volume and price per ton for the period 1972-1981 in Appendix 8. The direction of world trade in alcohols and phenols for Canada may be found in Table 111.

TABLE 113

WORLD
ESTIMATED METHANOL CAPACITY, SUPPLY AND SURPLUS

(thousand tonnes per year)

Area	1979				1983**			
	Nominal Capacity	Supply	Demand*	Surplus (Deficit)	Nominal Capacity	Supply	Demand	Surplus (Deficit)
Canada	495	400	180	229	1,895	1,440	205	1,235
Mexico	165	140	95	45	165	140	115	25
United States	3,550	3,195	3,180	15	5,580	4,660	3,735	925
Latin America and Caribbean less Mexico	185	160	190	(30)	585	360	240	120
Western Europe	3,665	3,115	2,955	160	4,025	3,265	3,550	(285)
U.S.S.R. & Eastern Europe	2,920	2,335	1,880	455	3,440	2,690	2,285	405
Japan	1,260	1,010	1,060	(50)	1,000	800	1,305	(505)
Other Asia & Far East	595	475	475	-	660	510	600	(90)
Saudi Arabia	-	-	-	-	-	-	-	-
Other Middle East and Africa	530	425	90	335	530	425	120	305
World Total	13,315	11,255	10,105	1,150	17,880	14,290	12,155	2,135

Source: Emerging Energy and Chemical Applications of Methanol, World Bank 1982.

*Disregards all methanol fuel uses.

**Projected.

Table 113 indicates there is a world surplus of methanol capacity and supply. The deficit in supply shown for Japan in the table is probably due to the fact that naptha is used as a feedstock. Of even greater interest is the productive capacity of methanol in Canada which, in 1979, amounted to 400,000 tonnes per annum, 3.5% of the world's effective capacity. The surplus supply in 1979 amounted to 220,000 tonnes, 19% of total world net surplus. The data for 1983 show the extraordinary increase by which Canada now accounts for nearly 60% of the world's surplus.

Ethanol

Supply and demand patterns for ethanol are not available in as much detail as those for methanol. In addition, the nature of production by fermentation and synthesis of wood sugars, and the many end-uses for both human consumption and for further chemical processing, have so far precluded the compilation of comprehensive statistics.

The production of ethanol from wood material by acid or enzyme hydrolysis through the glucose chain is part of a complex series of reactions. To aim at the production of ethanol as a major product would require an evaluation of marketing the other major products in the chain, i.e., polyols, several acids, yeasts, xylitol and furfural.

The best available statistics are those from the World Bank which are presented in Table 114.

TABLE 114 WORLD: ESTIMATED ETHANOL PRODUCTION, 1977

(thousand tonnes)

Country/Region	Synthetic	Fermentation	Total
United States	588	42	630
Canada	168	Negligible	168
United Kingdom	215	39	254
France	95	226	321
Germany, Fed. Rep. of	101	82	183
Other EEC	N.A.	214	214
Japan	80	110	190
India	4	340	344
Brazil	Negligible	525	525
Eastern Europe	85	N.A.	85
Others	100	N.A.	100
Total	1,436	1,578	3,014

Source: Alcohol Production from Biomass, World Bank, 1980.

N.A. Not available.

The actual production of fermentation ethanol is likely much higher than indicated in Table 114, since considerable quantities of such production are not reported in international statistics. Historically, production of synthetic ethanol has been declining since the early 1960's.

Consumption of ethanol for 1977 has also been estimated by the World Bank as shown in Table 115.

TABLE 115

CONSUMPTION OF INDUSTRIAL ETHANOL FOR MAJOR REGIONS BY END USE - SELECTED MAJOR MARKETS - 1977

(thousand tonnes)

Region	Solvent	Chemical Raw Materials	Other	Total
United States	336	260	17	613
EEC	320	471	77	868
Japan	48	18	41	107
Totals	704	749	135	1,588

Source: Alcohol Production from Biomass, World Bank, 1980.

From comparison of the two foregoing tables, it is apparent that even within major consumption areas, a substantial oversupply exists for industrial ethanol; i.e., in the U.S., supply exceeds demand by 3%, in the EEC by 12% and in Japan by 77%.

Butadiene

World production of butadiene in 1979 approached some 3 million tonnes. Table 116 lists figures for major producing countries of butadiene from 1970 to 1979. However, as previously stated, the absence of reliable statistics will permit only an approximate evaluation of markets for this product.

TABLE 116

OECD COUNTRIES
PRODUCTION OF BUTADIENE

1970 - 1979

(thousand tonnes)

	1970*	1971*	1972**	1973*	1974*	1975	1976	1977	1978	1979
Germany	1,814	396		460	490	287	406	437	463	502
Spain	92	43		128	201	39	29	41	49	77
Finland	-	-		0	13	6	14	15	18	17
France	932	291		-	-	172	236	255	287	-
Italy	-	106		172	187	157	181	185	175	166
Netherlands	559	266		514	-	290	416	374	421	442
United Kingdom	988	188		217	212	174	230	214	209	227
Sweden	157	-		-	-	-	89	63	75	-
Austria	58	29		26	-	-	-	-	-	-
Canada	407	-		-	-	134	145	-	-	-
U.S.	-	-		1,661	1,658	297	1,476	1,591	1,594	-
Japan	3,250	2,134		2,404	2,374	529	601	601	658	-

Source: The Chemical Industry, OECD

*Includes Butylene
**No statistics reported.

The statistics for most of the countries consistently show sharp drops in production for 1975 which reflects the overall world wide economic slump which commenced at that point. Gradual recovery of production then took place. The U.S. and Japan are by far the largest producers of butadiene. Canada has four plants capable of producing butadiene, but no statistics on production are available. Polysar, in Windsor, Ontario, is the world's largest producer, making butadiene from naptha and methanol.

End-Use Markets

The chemical industry is both its own principal supplier and its best customer. This is due to the processing chains that involve many intermediate steps in the transformation of chemicals. The other main markets of the chemical industry are agriculture and the textile, food, rubber and paper industries. Each of the major chemical groups of particular interest to this study is discussed separately.

Methanol

More than 95% of today's methanol market is in chemical applications. This includes traditional chemical uses as well as two new applications established during the 1970's. The principal new application has come from the commercialization of a new and significantly more cost-effective process using methanol to produce acetic acid, which has been traditionally made from other raw materials. Similar changes to the use of methanol, as a basic feedstock in the production of other chemicals currently made from ethylene, are envisaged for the longer term.

In 1979, the U.S., Japan and western Europe accounted for more than 70% of the estimated world methanol market, in which the various chemical applications of methanol were as follows:

TABLE 117 CHEMICAL USES OF METHANOL IN THE COMBINED U.S., WESTERN EUROPEAN AND JAPANESE MARKET

(1979 Estimates)

	Share of Chemical Methanol Market on a Volume Basis	
Traditional Uses	(%)	
Formaldehyde	49.2	
Solvent	9.5	
Methyl Halides and Chloroform	6.8	
Methyl Amines	5.2	
Methyl Methacrylate	4.9	
Dimethyl Terephtalate (DMT)	4.9	
Miscellaneous	15.2	
		95.7
Recently Established Uses		
Acetic Acid	4.2	
Single Cell Protein (SCP)	0.1	
		4.3
		100.0

Source: Emerging Energy and Chemical Applications of Methanol, World Bank, 1982.

As a conservation measure, there is a great deal of promotional activity to encourage the use of methanol as a substitute for gasoline. The relative merits of methanol versus ethanol for this purpose are being seriously debated though, so far, no serious commitment has been made to methanol. Both of these chemicals can be obtained from poplar wood, although it has not yet been demonstrated that this can be done competitively with natural gas or petrochemical feedstocks.

Phenol Derivatives (Low Molecular Weight Phenols and Methylated Phenols)

One of the most obvious uses for low molecular weight phenols and methylated phenols derived from poplar is as a substitute for phenolic and, to a lesser extent, urea formaldehyde resins in panelboard production.

Current capacity of phenol formaldehyde and urea formaldehyde production for use as adhesive/binders by the North American forest industry is shown in Table 118.

TABLE 118

PRODUCTIVE CAPACITY OF PHENOL FORMALDEHYDE AND UREA FORMALDEHYDE RESINS FOR USE AS FOREST BASED BINDERS

(millions of kg)

Resin Type	Canada	U.S.	Total
Urea Formaldehyde	40	160	200
Phenol Formaldehyde	75	185	260
Totals	115	345	460

Source: Field interviews.

Discounting the substitution for urea formaldehyde resins (since colour changes have been a serious problem), it is apparent that a portion of the 75 million kg Canadian phenolic market and, possibly, a portion of the U.S. market for plywood and waferboard resins could be penetrated by poplar based, low molecular weight phenols and derivatives.

As a consequence of work originally instituted at Forintek Canada Corporation, a number of major Canadian and American panelboard producers have conducted intensive trials of lignocellulosic-based adhesives as a substitute for synthetic phenol-formaldehyde adhesives. In addition, a licencing agreement has been concluded between Forintek and Tembec (Canada) Ltd., Temiscaming, Quebec, for the manufacture and sale of methylated low molecular weight phenols. Commercial use of the substitute resin has been limited to this point. However, research is continuing by major consumers, as well as by the two producers of synethetic resins: Borden Chemicals and Reichhold Chemicals.

Current research has indicated two major problems with the substitute material.

1) There appear to be practical limits to substitution, at approximately 20% by weight of the resin solids, after which finished product quality deteriorates.

2) Extreme variations in properties of raw materials produced unsatisfactory results in test panels.

Current research is aimed at stabilizing the substitute raw material through purification. However, due to the extremely corrosive nature of the product, the cost of purification equipment and processing may be prohibitive.

In addition to the use of phenols (and their derivatives) as adhesives, markets may exist for pure lignins as additives to drilling muds. This application and the potential market volume is not well defined, and may not be available to aspen based lignin until such time as research into organosolvents or similar processes is complete.

Assuming that all of the current technical objections can be resolved, it is apparent that a Canadian market of up to 15 million kg per annum could develop for lignin-based adhesive, based on the apparent substitution factor of 20%, previously noted. This will likely be attainable provided that the cost of product is competitive with synthetic phenolic resins currently selling at $1.00 per kg, on a dry solids basis. This market appears to one of the more promising chemical markets for chemicals derived from poplar.

Ethanol

Ethanol is used as a chemical in toiletries, cosmetics and pharmaceuticals, and as a feedstock for the production of other chemicals such as acetaldehyde. It is being used increasingly as an additive to, or substitute for, gasoline. For the production of beverages, only ethanol derived from fermentation is used.

As an example of the relative proportions of various ethanol uses, consumption in the EEC is shown for the year 1979 in Table 119.

TABLE 119

ETHANOL USES, EUROPEAN ECONOMIC COMMUNITY, 1979

(thousand tonnes)

	Beverage Consumption	Vinegar	Pharma-ceuticals	Toiletries	Industrial and Others	Total
Belgium	3	1	1	2	13	20
Denmark	8	1	4	1	11	25
Germany	57	9	5	9	113	193
France	85	6	10	28	113	242
Italy	46	-	12	13	48	119
Netherlands	25	1	1	2	18	47
United Kingdom	40	2	2	22	148	214
Others	1	-	-	-	7	8
Total EEC	265	20	35	77	471	868

Source: Alcohol Production from Biomass in the Developing Countries, World Bank, 1980.

One third of the use of ethanol was for beverage consumption and vinegar, and the balance, about 61%, was used for industrial chemicals and energy in the EEC in 1979. Denatured ethanol production (alcohol rendered non-drinkable by trace additives) in the U.S. has been declining recently because of competition from low cost petroleum-derived feedstocks, but the limits of substitution appear to have been reached. Future total ethanol consumption in the U.S. is expected to grow at a rate of 3% per year from 613,000 tonnes in 1978 to 688,000 tonnes in 1983.

The use of ethanol as a substitute for, or additive to, gasoline has been adopted recently in many countries and has received widespread acceptance. In Brazil, for example, a vigorous program of fossil fuel substitution has been undertaken. In 1979, 19% of fuel consumption was accounted for by a mixture of ethanol and gasoline, referred to as gasohol.

There is approximately twice the productive capacity of ethanol in Canada as there is current consumption. Major producers are Ashland Chemicals and Commercial Alcohols Ltd.

Acetone

Shell Canada produces acetone from isopropyl alcohol. The competing companies such as Gulf Canada produce it as a by-product in the production of phenols. The volume of phenols produced varies with the fluctuations in production in the panel board industry.

The market for acetone is about 20,000 tonnes per year in Canada. In the United States, capacity is about 1.25 million to 1.3 million tonnes, while consumption has been about 700,000 to 800,000 tonnes. It is felt that over capacity in the U.S. will last about 10 years.

The major use for acetone in Canada is as a solvent, while in the U.S. it is used as a feedstock for plastics such as plexiglass.

Butadiene

Butadiene is used principally for the manufacture of synthetic rubber. Butadiene experienced fairly strong growth rates until the world economic downturn which sharply affected the market for synthetic rubber.

Butanol

Butanol is used primarily as a solvent for many chemicals and also for the synthesis of dibutyl propylene. Since B.A.S.F. is the only company producing butanol in Canada, trend data on these products are not readily available.

Furfural

There are no producers of furfural in Canada. The market is estimated to be about 225 tonnes per year in Canada. Furfural is used mainly in the extraction of lubricating oils. The Quaker Oats Company is the major producer in the U.S., where it is extensively used by the synthetic polymer industry in the production of a wide range of chemicals including nylon, polyurethane foams, resins, plastics and some drug products. Extensive research in each of these (and other) end-uses for furfural would have to be completed in in order to develop demand trends.

Glycerol

Glycerol is a chemical industry by-product that is used in the manufacture of soaps and plasticizers for the plastics, adhesives and coatings industries.

Butylene Glycol

This chemical is used primarily as an intermediary in the production of butadiene which, in turn, is used in synthetic rubbers and plastics.

Salicin

This compound is an extractive from cellulose and hemicellulose of poplar and willows. It is not yet commercially available, but research has shown it has strong analgesic properties and pharmaceutical manufacturers are of the opinion that the product could have the same value as that of salicylic acid.

Xantham Gums

These gums are used primarily in the manufacture of paints and coatings.

Lactic Acid

Lactic acids are used as a basis component in adhesive manufacture and in food preservative additives.

Hydroxymethyl Furfural

This compound is used as an intermediate chemical in the synthetic polymer industry for the production of nylon, polyester, resins, levelinic acid, plastics and drugs.

Vanillin

Vanillin is a wood-based product produced in Canada in substantial quantities from waste liquor by the Ontario Paper Company in Thorold, Ontario, which has a current capacity of some 2,700 tonnes per year. This is mostly marketed in Europe for use in the manufacture of pharmaceuticals.

Sweeteners

Glucose, xylose, sorbitol and xylitol can all be produced from poplar and are presently used as sweeteners for food products. If these chemicals were to be produced from poplar, a formidable array of stringent quality control measures would have to be complied with in order to obtain approvals from Federal and Provincial regulatory agencies to use them as food additives.

The Canadian market for sorbitol is approximately 7 million kg per year and is increasing at about 2% annually. It is produced by one company in Canada, Atkemix Inc., and is used mainly in toothpaste (70%), as a sweetener in soft drinks and dietary cookies, and in cosmetics.

In Canada, the only use allowed for xylitol is in the production of Adams sugar-free chewing gum. It has been restricted in its use in Canada because of medical side effects and requires further study. In the U.S., it is used as a substitute for sucrose by diabetics and as a sweetener in other products.

Glucose and xylose, while consumed in major volumes in Canada, are solely produced from sugar cane and sugar beet.

Quality Standards

In general, there are no standardized international government or association rules or specifications governing the quality of primary chemicals. All quality specifications and standards are agreed upon between buyer and seller, and both maintain quality sampling and analysis programs which govern each shipment. Despite the fact that, in the processing of hydrocarbons, the constituents fall out in rigidly consistent patterns under technology which has been in place for years, there are still requirements for quality control measures.

Japan has probably the most stringent quality specifications for both raw material feedstock and finished chemical products. In order to facilitate trade, Canadian and U.S. exporters are presently establishing Quality Control Councils which will develop, implement, and monitor specifications to guarantee a consistent quality standard for chemicals included in the Councils' terms of reference. These terms of reference include most of the primary chemicals discussed in this report. Although the Councils have been established primarily to satisfy the demands of Japanese importers, the standards to be implemented will apply to shipments to all markets. Although the lack of overall industry standards may be surprising, the closely knit, interwoven nature of the chemical industry has, to this point, apparently made such control superfluous.

Competitive Products

The greatest obstacle to the production of chemicals from poplar is the cost at which the the same chemicals can be produced from petroleum and natural gas. Most chemical industries started by using naptha, produced from the cracking process for liquid petroleum, as a raw material for producing ethylene, the basic feedstock in the petrochemical industry. More recently, ethylene and methyl alcohol have been produced more cheaply from natural gas, and this development has caused severe disruption to the petrochemical industries of Japan, Korea and other major producers which are still based on petroleum. An example is the production of acetic acid from ethane-based methanol. The importation of low cost methanol, in competition with the established domestic industry in Japan, has had repercussions all down the line in the secondary and tertiary industries that produce a vast number of products such as plastics, fibres, paint solvents, flavors and fragrances, fertilizers, pharmaceuticals, etc.

In order to compete with this large, established industry which offers inexpensive feedstock, chemicals produced from wood must meet commodity prices on a world market.

Competition is also present from the agro-industry. For example, sweeteners potentially derived from poplar, which include glucose and xylose, would have to compete with those products which have been obtained on a large scale, traditionally, from sugarcane and sugar beets and which are traded on the commodity market.

These agricultural-based sweeteners are also subject to competition from petrochemical derivatives such as saccharin, cyclamates and, more recently, sorbitol. The productive capacity of the four plants producing sorbitol in the U.S. is 184.5 million kilograms. This substance is gradually replacing saccharin in the market on the basis of price.

Again, the depth of research necessary to justify investment decisions becomes apparent. Each potential use, whether a second, third, fourth, or fifth-stage chemical, would require careful market analysis to identify the overall market trends for the selected feedstocks to be derived from poplar.

Distribution Mechanics

Two major Canadian producers of petrochemicals, Dow and Monsanto, maintain a global network of distributors who handle all bulk sales. Other major producers have distributors in their main markets and use independent brokers in the rest. However, for specialty items in small shipments, independent brokers are employed. The remainder of the industry employ brokers and distributors in the various markets. Contractual arrangements may or may not exist with these brokers/distributors.

Transportation Considerations

Transportation of all bulk chemicals can be by pipeline, railway tank car, tank truck and deep sea tanker. Pipelines are used for relatively short distances between refineries and petrochemical plants or deep-sea loading terminals. Tank trucks are used for smaller quantities of specialty products.

The chemical transportation system in Canada is a combination of rail car, storage and loading terminal and tanker. Tank cars that conform to the "Regulations for the Transporation of Dangerous Commodities by Rail", issued by the Canadian Transport Commission, must be used for each specific chemical. This control is administered by the Dangerous Commodities Section of the Operating Department, Railway Transport Committees, Canadian Transport Commission. The regulations specify the type of car construction, linings, fittings, temperatures, pressures, car markings, and other factors relevant to the specific chemical involved.

Some specialty chemicals are shipped in drums or carboys made from materials that will not break down in contact with the chemical to be exported. There are also special regulations as to the size, volume, content and packaging of the container for export shipment under the United Nations International Marine Container Organization (IMCO) code. This organization has established a number for each dangerous chemical and specifies the label required, type of packaging, net quantity per package and other requirements for transportation.

Most sea shipments are transported in chartered tankers. In long term contracts, one or two ships are leased from a shipping company in the importing country and these run back and forth under regular service. Most chemical shipments are carried out by spot charter. Each tanker chartered must conform with the IMCO code for the particular chemical being exported. Water transportation also must abide by the "Regulations Respecting the Carriage of Dangerous Goods in Ships" issued by the Department of Transport, Ottawa, administered by the Marine Regulations Branch.

Major costs are incurred in cleaning tanks and fittings, before shipping, in order to ensure no contamination from the previous cargo. Other major costs are terminal and through-port charges.

For any new large scale plant starting up with large volumes to be transported, new producers would have to include capital costs for tank cars, tank trucks or specialized tankers, as most of the existing cars are already under contract. There are a large number of well-equipped export terminals in eastern Canada but, in the west, only Vancouver and Kitimat are equipped to process chemical shipments. This aspect would also have to be analyzed as a part of any feasibility study for a new industry coming into the market, as the capital cost of holding tanks, transfer facilities and docks would be substantial.

Price Relationships

Because of the size and nature of the chemical industry, the raw materials are all considered to be bulk commodities and are subject to international market prices. The most detailed source of international market prices is the Chemical Market Reporter which is issued weekly from Chicago, U.S. and which lists most common chemical products and international prices. This source, together with Statistics Canada Reports, have been used for prices in this report.

Prices on the international market follow closely the laws of supply and demand and variations in the cost of production. The cost of products of the petrochemical industry have risen in general in conjunction with the cost of oil since 1974. When demand exceeds supply, more capacity is built and the increased supply exerts a downward pressure on increases in price. However, when demand slips, such as recently happened in 1977-78, and is currently happening, prices level often fall. New technology also influences price, as has recently been the case, for example, in the production of acetic acid. These relationships are shown in Table 120, and explained more fully on the next page.

TABLE 120 PRICE HISTORY FOR ACETIC ACID

(1973 - 1982)

Year	Price US$/kg	Year	Price US$/kg
1973	.20	1978	.40
1974	.34	1979	.46
1975	.33	1980	.54
1976	.38	1981	.59
1977	.40	1982	.51

Source: Chemical Market Reporter - December, 1982

The tremendous changes in the price of petroleum by OPEC are reflected in the price of acetic acid in 1974. The price had doubled by 1977. The recession of 1977-78 is reflected in the price being held constant for these years, after which prices again rose at an average annual rate of 16% per year. In 1982, the price dropped sharply by 14% as a combined effect of lowered demand due to the present world recession and the supply of cheaper feedstock chemicals.

Price levels for major products such as ethanol, methanol and butadiene all experienced sharp increases from 1974 to 1982, following the increases in the price of petroleum. Figure 17 shows the prices of methanol and ethanol during the 10 year period 1973-1982.

The greater volatility of ethanol prices, in comparison with those for methanol, will be noted in the figure. This is primarily because, at this time, there is a world-wide excess capacity of methanol as shown in Table 113. This is having an effect in B.C., as evidenced by the marketing problems presently being experienced at Ocelot Industries new methanol plant in Kitimat, B.C.

Ethanol, on the other hand, has both a large number of producers and consumers with highly varied end products, all of which influence the supply/demand picture and, therefore, the price structure.

Wood has not been used as a feedstock for the production of chemicals on a large commercial scale in North America, and it is difficult to make direct comparisons of the costs and prices with competing feedstocks from petroleum and natural gas. Estimates have been made for comparative purposes, however, for methanol and ethanol production, and these may be accepted as "order-of-magnitude" competitive comparisons and are discussed in the following paragraphs.

Price With Relation to Production and Cost

Methanol

Current methanol production is based on natural gas (methane) as a feedstock and, under current market conditions, a 910 million litres per year methanol plant is considered to be the smallest, economically feasible plant.

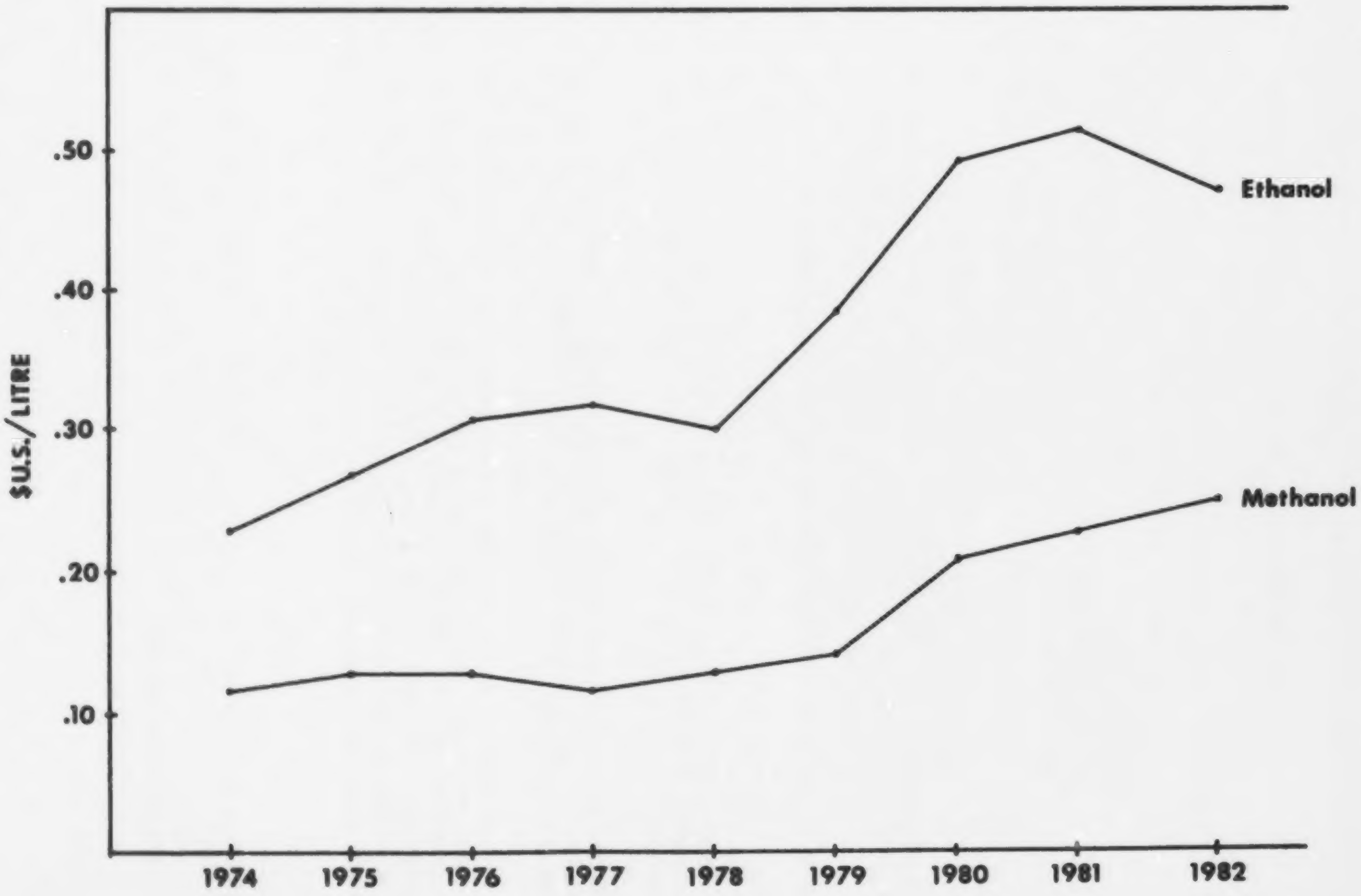
High temperature pyrolysis of dry wood, with total exclusion of air, produces up to 85% of gas rich in hydrogen which can be used as a synthesis gas for the production of methanol. Low temperature pyrolysis yields gas, distillates and tars, of which the distillates contain methanol, acetic acid, acetone and small amounts of other chemicals but none in sufficient concentration to warrant recovery.

Methanol derived from wood biomass requires a suitable synthetic gas feedstock consisting of carbon monoxide, hydrogen and methane which is produced from a thermal conversion process. In the conversion of this gas to methanol, multiple passes over a catalyst are required and the resultant efficiency is approximately 60%.

The process involves the application of heat to the biomass material, resulting in a covalent bond rupture and reformation of gases, char or oils. Synthesis gas, i.e., hydrogen (H_2), and carbon monoxide, are combined catalytically to produce methanol : $2H_2 + CO - CH_3OH$.

FIGURE 17

PRICE HISTORY FOR METHANOL AND ETHANOL



Source: Yearbook of International Trade Statistics, UN 1981

An example of the costs involved in producing methanol is shown below:

Cost of Methanol from Wood, Using Oxygen Gasification

Production of 151 million litres per year of methanol

Input 2000 tonnes green wood per day, 330 days per year - 660,000 tonnes

Methanol yield is 454 litres per dry tonne of wood.

Capital Cost	US$ Millions
Fixed investment	80
Working Capital	8
Total Capital Cost	88

Production Costs	US$ per Gallon
Wood ($30 per green tonne)	.493
Labour, water, chemicals	.026
Electricity	.152
Capital charges	.657
Total Production Cost	1.33

Source: Congress of U.S., 1982.

This amounts to US$ .35 per litre. Comparing this figure with the 1981 commodity pricing for methanol of US$ 0.23 per litre, it is apparent that the hypothetical plant would be in a substantial loss position.

Additional price estimates can be obtained from costs which have been developed from laboratory and pilot plant projects. A major variable is, of course, the cost of wood delivered to the plant.

It is further interesting to note that a total wood input volume of approximately 330,000 dry tonnes would be required to produce the projected 151 million litres. Assuming an average specific gravity of 0.48, the volume (SWE) required to support the plant would be approximately 625,000 cum per annum. To provide this volume of wood, assuming a volume of 90 cum per ha, it would be necessary to log nearly 7,000 ha per year which, on a sustained yield basis of 60 year rotation, requires a forest reserve of some 420,000 ha.

Ethanol

Ethanol may be produced from poplar (or other wood species) by fermentation followed by distillation, the same process as is currently used for production of "drinking" alcohols from various grains. A world scale capacity plant would be considered to be a minimum of 190,000,000 litres per year.

The following cost and yield estimates appear reasonable for the cost of ethanol production.

Cost of Ethanol Production

Wood supply of 600,000 tonnes per year.
Ethanol production of 189,200,000 litres.

Production Costs	US$
Cost of feedstock $38.80 per tonne	$23,300,000
Fixed and variable costs	34,700,000
Cost of capital (30% of capital)	39,600,000
Total production cost	$97,600,000
Production cost per litre	$.52

Source: U.S. National Alcohol Fuels Commission, 1981.

Again, as with methanol, comparing this US$ 0.52/litre estimated cost of production with the current commodity pricing for ethanol of US$ 0.47/litre, it is apparent that the projected plant would not generate a profit under present conditions.

A further important factor is the volume and area of forest required to support the plant.

Poplar volumes per hectare in the forests of Alberta and B.C. range between 7 and 60 cum per ha, while in pure stands this can increase to 96 cum per ha. Since a large proportion of the forests are overmature, there is a large decay factor variously estimated to be between 20% and 60%, depending on location, site and age of stand. If an optimistic volume per acre of 90 cum per ha is assumed and no reduction is made for decay, the net volume available per hectare would be 90 cum per ha. Thus, for a production of 600,000 tonnes per year, at a volume of green wood of 2cum per tonne, an area of 13,333 hectares would have to be harvested per year. If the wood supply area were to be cut on a sustained yield basis and a rotation of 60 years assumed, the total supply area required would be approximately 800,000 hectares.

In order to put in perspective the areas theoretically required for the methanol and ethanol plants used for estimating costs, Table 121 shows the deciduous forest in Alberta with estimated volumes per hectare of poplar. No similar information is available for B.C.

TABLE 121

ALBERTA
DECIDUOUS AREA BY FOREST

Forest	Volume per Hectare (cum/ha)	Pure and Predominently Poplar Stands (thousand ha)
Footner Lake	76	1,692
Peace River	87	695
Grande Prairie	104	604
Slave Lake	94	1,475
Athabaska	50	698
Lake La Biche	98	485
Edson	84	214
Whitecourt	111	380
Rocky-Clearwater	110	196
Bow-Crow	50	86
		6,525

Source: Energy and Chemicals from Wood, Alberta, 1979.

It would appear that the forests with sufficient area and adequate volume per hectare to support the methanol plant are Grande Praire, Slave Lake, and Lake La Biche, and for the ethanol plant, Grande Prairie and Slave Lake.

At present, most industrial ethanol is produced from petroleum or natural gas. Thus, the cost of industrial ethanol is directly related to petroleum or natural gas. As its cost continues to climb parallel to the cost of oil and gas, fermentation-derived ethanol will become more attractive. The most attractive market for fermentation ethanol plants is for alcohol to be used in blending with gasoline. Gasohol has a slightly lower thermal value per unit volume than gasoline, but no significant fuel-mileage decrease has been recorded. The addition of ethanol to gasoline increases the octane rating and can take the place of tetraethyl-lead, without the supplementary energy expenditure in the refining process.

Both Canada and the U.S. are encouraging the use of gasohol as a measure to reduce the demand for petroleum. Besides monetary incentives, the Canadian government is supporting research in the production of ethanol from wood at the Canertech Ltd. pilot plant in Winnipeg which will use the acid hydrolysis process. They estimate that the cost of production is C$ 0.70 per litre, compared to a current market price of C$ 0.55 or US$ 0.47.

The American policy to enhance the economic attractiveness of producing ethanol includes an exemption on excise tax and an additional 10% investment tax credit for facilities that convert alternative feedstocks to liquid fuels. A number of states have also eliminated the fuel tax for ethanol blends or gasohol.

In 1979, approximately 227.5 million litres of ethanol were used to produce gasohol in the U.S. Common reaction has been favourable relating to engine performance. Test market results show penetration rates of 8-30% of overall gasoline sales. The price of only anhydrous industrial ethanol was about US$ 0.53 per litre in 1980, wholesale fob plant in the U.S. The price of ethanol based on agricultural feedstocks is dependent on a number of factors such as type and price of feedstock, etc. and recent estimates suggest that market prices range from US$ 0.34 to US$ 0.44 per litre.

Estimates of transportation costs have not been made in this report because these costs are completely site and product specific. It can be said, however, that transportation costs of feedstock would be much higher for wood transported from forest or log processing facilities to a plant.

Trade Inhibitors

Tariffs

The tariff structure for chemicals varies from country to country according to the General Agreements for Tariffs and Trade (GATT). Each chemical is covered by a particular duty. A detailed analysis of the duties applied to each potential chemical is beyond the scope of this study, and is more properly a part of a detailed feasibility analysis.

The alcohols imported into the U.S. for energy, such as for gasohol, are duty free. However, those imported for industrial purposes incur a 20% duty.

Non-Tariff Barriers

One non-tariff barrier is the requirement in all countries for toxic chemical testing. Each country has a different set of requirements and for new chemicals this can become expensive. For the chemicals being regularly exported, information already on hand can be used. However, for new products, animal tests are usually required and all costs of the test procedures, which can be extensive as well as expensive, are the responsibility of the potential chemical supplier.

Future Demand

The indices of production for the OECD, the U.S. and Japan, previously shown in Figure 14, indicate that the production of all chemicals has increased 76% for the U.S. between 1970 and 1979, and 60% for the other two areas. This was about 30% greater than the increase for total industrial production.

World trade in organic chemical shows a long-term upward trend, despite the present reduction of industrial activity due to depressed world economic conditions. World imports increased by 109% and world exports by 108% during the period 1976 to 1980, equivalent to annual increases of 21% which is far larger than the growth of any other group of trade commodities.

The Japan Chemical Annual estimates that the domestic demand for ethylene, which may be produced from ethanol, will increase to 4.05 million tonnes in 1985 and to 4.75 million tonnes in 1990.

The petrochemical industry in Korea has shown a growth rate of 18.6% from 1972 to 1981. Estimates are that demand for ethylene will increase from 575,000 tonnes to 955,000 tonnes from 1982 to 1986, an increase of 66%, while the supply will increase from their own industry by 70%.

An example of the future demand for a specific product, methanol, is indicative of the future demand for a large number of bulk chemicals in international trade. Table 122 shows the projected world demand and supply for methanol to 1990.

It should be noted that, in 1983, the world net oversupply for methanol will amount to 2.135 million tonnes, and the oversupply capacity is projected to increase to 3.155 million tonnes by 1990.

Canada, with an effective capacity of 1.44 million tonnes per annum in 1983 or 10% of world capacity, has a surplus of 1.255 million tonnes, amounting to 58% of the world's net surplus.

It is not expected that other chemicals will develop such a large surplus position, which has been brought about largely by the world economic slump. Methanol is taking the place of ethylene for the secondary manufacture of chemicals in major segments in the industry and the surplus projected in Table 122 may therefore be excessive.

The indicated trends are, however, that the petrochemical industry is becoming more and more competitive, and has excess capacity already in place capable of producing most chemicals, and prices will tend to be low well into the future. Future demand, however, has also been shown to be strong and, thus, such factors as price, quality, prompt delivery and trade terms will have a strong bearing on successful entrance in the market. New chemical plants under construction should be subjected to a product and site-specific analysis prior to decision making.

TABLE 122

PROJECTED WORLD DEMAND AND SUPPLY OF METHANOL

(thousand tonnes)

	1983			1985			1987			1990		
	Supply	Demand	Surplus (Def.)	Supply	Demand	Surplus (Def.)	Supply	Demand	Surplus (Def.)	Supply	Demand	Surplus (Def.)
North America and Mexico	6,240	4,055	2,185	7,275	4,395	2,880	7,565	4,795	2,770	7,565	5,465	2,100
Of which:												
Canada	1,440	205	1,235	1,705	220	1,485	1,705	235	1,470	1,705	260	1,445
Mexico	140	115	25	550	130	420	840	145	695	840	165	675
United States	4,660	3,735	925	5,020	4,045	975	5,020	4,415	605	5,020	5,040	(20)
Latin America and the Caribbean (Excluding Mexico)	360	240	120	665	270	35	775	300	475	775	360	415
Western Europe	3,265	3,550	(285)	3,890	3,890	5	4,230	4,375	(145)	4,230	5,225	(995)
U.S.S.R. and Eastern Europe	2,690	2,285	405	3,475	2,520	955	3,910	2,775	1,135	3,910	3,215	695
Asia and Japan												
Of which:												
Japan	800	1,305	(505)	800	1,445	(645)	640	1,525	(885)	640	1,650	(1,010)
Other Asian and Far East	510	600	(90)	840	675	165	1,055	760	295	1,055	905	150
Middle East and Africa	425	120	305	1,550	135	1,415	1,980	150	1,830	1,980	180	1,800
WORLD TOTAL	14,290	12,155	2,135	18,500	13,330	5,170	20,155	14,680	5,475	20,155	17,000	3,155

Source: Emerging Energy and Chemical Applications of Methanol, World Bank, 1982.

Charcoal

Charcoal, produced by the destructive distillation of wood by heating it in a closed retort in the absence of oxygen, may be considered as a source of both energy and a chemical product. The term distillation implies the recovery of gases, tars, pyroligenous acids, etc., but, in the context of this section of the study, the production of charcoal is the primary object. The process is, therefore, more properly defined as carbonization, and the resultant products are as follows:

Fuel Charcoal

Fuel charcoal refers, mainly, to the production of lump charcoal or briquettes for the outdoor barbecue trade and miscellaneous heating systems. In Canada, this market has attracted many small and large investors due to the fact that, frequently, investment may be minimal. However, attrition has been heavy and only the relatively large companies, with full facilities for bagging and briquetting, have survived. Limits are imposed by the quality, form and density of the raw material. Poplar, being of low density, has not been successfully utilized. Dense species such as birch and maple are the favoured types. A major factor in the industry is the production of charcoal, mainly briquetted, from lignite coal and petroleum mixtures. This is made domestically and is also imported.

Other uses for fuel charcoals include those for tobacco curing, metallurgical and industrial heating and agricultural heat. Some may be used for space heaters, providing adequate ventilation of gases is provided for.

Canadian shipments of all types of charcoal, from domestic sources, were 26,500 tonnes, valued at $8,400,000 in 1980, about 50% less than the volume in 1979.* Wood charcoal imports averaged 11,300 tonnes annually for the period 1980-1982. The average value of these was $3,900,000.

The history of charcoal production, based on poplar species, has not been encouraging and, therefore, it is not recommended that further investigation be carried out in the context of this study.

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*Statistics Canada

Industrial Charcoal (Activated Carbon)

This highly specialized form of charcoal may be made from numerous raw materials: wood (solid form), liquor from pulp mills, cellulose, lignite, coal, peat, nuts, cocoa shells, bones and others. The raw material is somewhat specific to the intended use. The carbon is made in powdered or granular form, with specific sizes and distribution of pores and a large surface area per unit of weight. Activation is accomplished in a secondary stage of manufacture by exposure of the carbon to high temperature steam, chemicals or gases.

The primary use of activated carbon is as an absorbent to remove colour or impurities from material in the following industries and processes: decolorizers for sugars, vegetable oils, organic solutions, potable water, inorganic salts, and alcoholic beverages; filters in air conditioners, gas absorbents for air pollution, odor removal, solvent recovery, fractionization of organic complexes, and protection against toxic materials in gas masks; ion absorbents for recovery of gold, silver, and other metals, pharmaceutical and medicinal products.

Water purification in industrial, municipal treatment and home water softening units and air filtration, followed by a wide range of industrial uses, consume the bulk of the activated carbon sold in Canada.

Canadian consumption for 1982 is estimated to be in the order of 6,000 tonnes, valued at $10,000,000. The market is considered relatively stable and there are no exports.

Imports of all types are reported as follows:

	Volume (kg)	Value (thousand $)	Average Value $ per kg
1980	5,190,413	6,786	1.31
1981	5,377,030	7,489	1.39

Source: Statistics Canada, Interviews.

The U.S. is the source of 84% of the volume imported, with varying amounts imported from the EEC, Japan and Puerto Rico.

The wholesale price, fob Toronto, for activated carbon made from coconut shells by the only Canadian producer, is about $4.50 per kg in 1983. This company also uses some maple from which the charcoal sells at $6.00 per kg. Consumption in the U.S. is estimated at more than 100,000 tonnes annually, produced by about 5 firms, employing a wide range of raw materials. There are numerous producers in other countries.

It may be possible, technically, to utilize poplars in the manufacture of activated carbon since, apparently, other low density cellulosic material is employed. Because the market is highly specialized, technically demanding and supplied by products made from various raw materials, the economics should be examined closely. It is not likely that very large volumes of poplar would be consumed under any circumstances and therefore a low priority may be allocated to this inquiry.

Conclusions

There is a rapidly expanding world wide market for petrochemicals. The industry, however, is highly integrated with well established trade channels, and operates under a very competitive price structure.

Chemical feedstock prices have levelled off as a result of a current surplus of oil in world markets and there is an ever increasing supply of natural gas. Both of these factors will inhibit competition from chemicals derived from presently expensive poplar wood sources.

A large volume of chemical production is necessary for a plant to compete in the bulk chemical market, which, in turn, requires a large capital investment. This could also include further capital for the purchase or lease of tank cars, ships and port facilities, depending on circumstances.

No cost estimates of a reliable nature are available for chemical industries based on wood feedstock. Estimates based on research work and pilot plants indicate, however, that the cost of production of methanol and ethanol from wood are too high for them to be competitive on local or world markets.

Ethanol appears to be the most likely chemical for viable production in the near future because of continued interest and support by the governments of the U.S. and Canada and the increasing acceptance of gasohol mixtures in the central states.

A further conclusion is that the volumes of fibre furnish required to support an international scale plant require excessive areas of forest to maintain consistent supplies of fibre. Sufficient areas are available in Alberta. However, transportation costs would be excessive.

Any development of chemicals by the forest industry, using wood as a feedstock, should be carried out in partnership with a large petrochemical company in order to compete in world markets. In this way, the technical expertise, infrastructure and established marketing facilities are immediately available. Before this can happen, the technology of harvesting and transporting of wood from the forest to the mill will have to be improved in order to be competitive with natural gas which is produced in the same general area as the poplar forests in Alberta and B.C.

It is recommended that support be given to research, pilot plant production and test marketing of ethanol derived from wood feedstock, with the objective of developing reliable cost data and measuring, more reliably than is presently possible, the degree of promotional/quality control activity required to gain reasonable market acceptance.

ANIMAL FEED

Introduction

This section of the report considers the use of poplar wood as a source of feed for animals, in both the Canadian and international markets. Two types of products are discussed, semi-processed fibre and chemically derived protein.

The cellulosic fibres in wood are similar to those in grasses and grains but possess a more complex molecular structure and contain more indigestible polymers, such as lignin, which require suitable treatment to allow normal digestion to take place.

Utilization of wood fibre as fodder is not a new concept. In the past, to conserve traditional and increasingly valuable food resources many substitutes have been investigated including wood residue or forest biomass from under-utilized species such as poplar.

This section discusses some of the most promising developments in this field. There is an ever increasing market for animal fodder in most countries as populations increase and land becomes scarce. The main emphasis in this report will be on the Canadian and American markets, though the possibilities of export to some Asian countries will be discussed.

Product Selection

A basic requirement involved in the preparation of animal feed is an economical method of breaking down the large complex molecules of hemicellulose, cellulose and lignin into simple carbohydrates and protein which are digestible by most animals. Of the processes developed to date, three appear to have the most promise: Mukka and Pro-Cell, both semi-processed fibres, and Single Cell Protein (SCP), a chemically derived protein.

Mukka

This process, developed in Russia during the 1940's, involves the fermentation of hardwood residues (leaves, branches, bark, and untreated sawmill residues). By simple aerobic fermentation of the coarse material in silage piles or silos, the long chain structures of hemicellulose and cellulose can be broken down in a relatively short period of time and the resultant product can be used as a partial substitute for standard feeds such as corn silage*. However, the long term effects of such feeding and utilization have not been fully explored in North America.

It has been suggested that differences in food taste may make the fodder acceptable to cattle in some regions of the world, but not acceptable in others.

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*Fisher, L.J., Canadian Journal of Animal Science

Pro-Cell

This process was developed by the Canadian firm, Stake Technology Ltd. The process employs a short dwell, high temperature, high pressure hydrolysis of poplar (or other hardwood) which results in a partially hydrolized fibrous feed material characterized by relatively high conversion to carbohydrate from cellulose and hemicellulose, leaving the lignin component virtually unchanged. This product shows promise as an adjunct to or interblend with other grain products and/or as a substitute for brome alfalfa in the feeding of animals. Furthermore, the nature of the partially fiberized product processed through the patented equipment is ideal for pelletization, which reduces the impact of transportation costs on the marketability of the feed stock.

The low capital cost estimated for a medium scale Pro-Cell plant is an added attraction for local manufacturing of animal feed supplement in regions which are short of natural fodder and/or areas with high transportation costs for hay.

Studies undertaken by Agriculture Canada indicate that approximately 20 to 30% of the total fibre roughage required by animals may be provided by Pro-Cell material to substitute for brome alfalfa without detrimental effect.

Single Cell Protein (SCP)

Single Cell Protein is essentially a pure protein material produced through the biological conversion of either pure cellulose, hemicellulose, or lignin (but not in combination) by selected strains of bacteria to form cell cultures. These cultures may then be killed, sterilized and used as protein supplements for a wide variety of domestic and agricultural animals.

Single Cell Protein has been proposed as a substitute for soylecithin in animal feed with the additional possibility of utilization for human food at some point in the future. At the present time, three major plants are either producing or under construction to produce single cell protein, each having different feedstocks and end markets.

a) ICI Ltd., Billingham, U.K. - This plant constructed in 1980, with a capacity of 80,000 metric tonnes per annum, was originally designed for production of SCP from agricultural biomass. A genetically modified strain of bacteria (DNA modified) was developed. However, in practice it was determined that because of variablity in the infeed raw material, a consistent product could not be obtained. As a result, in late 1981, the plant was modified to produce SCP utilizing the DNA modified bacteria and petrochemically produced methanol as feed stock. The entire output of this plant is currently being marketed in Europe as a feed supplement for poultry and hogs. This product has a net mill sales return of approximately US$600.00 per tonne.

b) Envirocon Process - The Envirocon pilot production unit (capacity 10 tonnes per day) is licensed to use the Inotech process developed by Professor Moo-Young, at the University of Waterloo, during the 1970's. This process, which will be on stream on a pilot basis by late 1983, will produce, by microbiological conversion from pulp mill primary clarifier sludge, a material containing approximately 30% crude protein by weight. It is anticipated that this will compete with soylecithin or soymeal in the animal feed market as a protein supplement. The anticipated selling price, based on a US$760.00 per tonne market price for 100% crude protein, will be approximately US$230.00 per tonne. It will be noted that the ICI process produces 80% crude protein which, on the basis of US$760.00 per tonne for 100%, yields a market price of approximately US$600.00 per tonne. It is anticipated that the Envirocon process will be applicable to aspen, provided that cellulose can first be extracted in an exposed form through a pulping process.

c) Carver-Greenfield Process (ITT Rayonier Inc.) - Current production at ITT Rayonier's Port Angeles, Washington pulp mill is 50 oven dried tonnes per day of low quality SCP from activated sulfite mill sludge (lignin). The process develops a 45% crude protein content with a current selling price US$145.00 per short tonne. Due to the variable nature of the product, sales are confined to the state of Washington, for cattle feed with minor amounts, about 10 tonnes per week, being marketed in British Columbia as an additive in mushroom culture.

It should be noted that all of the current processes for SCP have been marketed for animal feed. However, an additional market for SCP as a substitute for soylecithin for human consumption may be developed at some future date. This market has been determined to be, at least initially, in the sausage industry as an additive to "shrinkproof" sausage. This market will have an estimated product value of approximately US$2,000.00 per tonne. High quality soylecithin is also used in substantial quantities for incorporation in products such as Purina "Puppy Chow" to provide a moist appearance to the animal kibble as well as a high protein content during fast growth periods of the animal.

Regional Markets

Since there is, as yet, no established world market for poplar cellulose fibre as animal feed, the world and regional markets for coarse grains, grain by-products, and oilseeds will be discussed from the point of view of competing products. The main animal feeds (other than natural forage) are produced from these feed crops. World production and consumption of these products provides an indication of the total potential market for poplar-based feed products, as well as an indication of probable selling price levels and mechanics of distribution. It is worth reiterating that the following discussion of the world's grain industry is relevant to this study in that it provides the market framework into which poplar-based feed must fit.

Grain Production

The semi-processed fibre products, Mukka and Pro-Cell would have to compete in the same market as the major grains and grain by-products used for animal feed.

Five countries or regions produce 75% of the world's grains each year. Feed grains for animals represent about 48% of the 1,542 million tonnes of the world's grain production and the remaining 52% is used for human consumption. Table 123 shows world production for 1980-1981. Agriculture Canada estimates that total Canadian grain production during the 1980-1981 season was 38.6 million tonnes, consisting of 17.5 million tonnes of wheat and 21 million tonnes of coarse grains. Canadian grain production accounted for 2% of the total 1980-1981 world production of 1,542 million tonnes.

World grain exports during 1979-1980 amounted to 185 million tonnes of which the U.S. accounted for 59%, Canada 11%, Australia 10%, Argentina 6% and the remaining countries 14%.

TABLE 123 WORLD GRAIN PRODUCTION: 1980-1981

	Million Tonnes	Share %
U.S.	270	18
China	277	18
All Europe	256	17
U.S.S.R.	185	12
India	181	9
Five Countries or Regions	1,129	73
World	1,542	100

Source: Prospects for Agribusiness in the 1980's, Schnittker Ass.

Coarse grain provided most of the expansion in global grain supplies in crop year 1981-1982. Current estimates point to a 6% increase in these crops to 766 million tonnes. The U.S. coarse grain crop is estimated to total 245 million tonnes in 1983, 25% greater than in 1980-1981, resulting in a total supply that will be 12% larger than for 1981-1982.

The Soviet Union is one of the major importers of coarse grain and will import 29 million tonnes in 1981-1982. Coarse grain imports have been increasing in a number of Asian countries as well. From 1970 to 1977, the average annual growth rate of coarse grain imported by Hong Kong was 0.2%, Taiwan 13.7%, South Korea 17.6% and Singapore 28.0%.

Oilseed Production

Oilseeds, which can be converted to a wide range of food and related products, both for human and animal consumption, are important factors in the evaluation of markets for feeds derived from wood fibre. There are 5 major oilseeds grown in the world, of which Canadian rapeseed is a relatively small proportion. Canada also produces soybeans from which oil is extracted.

World oilseed production amounted to 174 million tonnes in 1979, of which soybean production comprised 53% as can be seen in Table 124.

TABLE 124 WORLD OILSEED PRODUCTION

Oilseeds	1979 (million tonnes)	1979 %	Producers	1979 (million tonnes)	1979 %
Soybean	93.4	54	U.S.	72.2	41
Cottonseed	25.0	14	China	17.5	10
Peanut	17.7	10	Brazil	16.5	10
Sunflowerseed	15.3	9	U.S.S.R.	10.4	6
Rapeseed	10.2	6	India	10.2	6
Other	12.4	7	Other	47.2	27
Total	174.0	100		174.0	100

Source: Prospects for Agribusiness in the 1980's, Schnittker Ass.

Increases in world production of oilseeds for 1981-1982 are predicted at 10% for meal (milling by-products) and 5% for edible oils extracted from oilseeds. In the U.S. the soybean crop is estimated to be up 28% from the 1980 level which had been reduced by drought.

Soybean Production

Soybean which represents 54% of the total world oilseed production is the main competitor for the animal food protein market for SCP. Table 125 shows world production of soybean from 1977 to 1980.

TABLE 125 WORLD SOYBEAN PRODUCTION: 1977-1980

(thousand tonnes)

Area	1977-78	1978-79	1979-80
United States	50,589	61,722	49,453
South America	14,613	19,286	30,155
China	7,600	7,500	7,500
Other Asia	892	885	891
Canada	516	671	713
Soviet Union	639	467	540
Europe	293	443	385
Korea	2320	330	330
Mexico	330	680	280
Japan	190	192	174
Africa	31	42	55
Taiwan	41	32	40
Other Countries	1,171	1,121	1,258
World	77,225	93,371	81,774

Source: Agricultural Statistics 1981, U.S.D.A.

It will be noted that of the nations of particular interest in this study, Korea, Japan and Taiwan have some production of soybean, although they are not self-sufficient in processed animal feeds.

The value of the soybean trade in Canada has increased enormously during the past 10 years, mainly because of the increased volume of imports. Table 126 shows the imports and exports of soybean and soybean products for 1972 and 1981.

TABLE 126

CANADA
IMPORTS AND EXPORTS OF SOYBEAN AND PRODUCTS

	1972		1981	
	Tonnes (thousand)	($ million)	Tonnes (thousand)	($ million)
Imports				
Oil, Cake and Meal	222	26	390	120
Soybean	308	39	374	115
Total	530	65	764	235
Exports				
Oil, Cake and Meal	89	9	51	18

Source: Statistics Canada

Canadian imports of soybean have increased from 308,000 tonnes in 1971 to 374,000 tonnes in 1981, an increase of 21% during the 10 year period. The increase in value of soybean and soybean product imports during the 10 year period was 350%, an average of 35% per year, while the relatively small volumes and values of exports doubled. The volume of imports and exports and value per tonne of soybean and soybean products for the period 1972-1981 can be found in Appendix 12.

Canadian Animal Feed Markets

Feed Grain

Exports of feed grains from Canada have risen from 2.2 million tonnes in 1973-1974 to 7.8 million tonnes in 1981-1982. This increase was a partial result of a reduction in the population of grain consuming animals in eastern Canada and British Columbia and the consequent reduction in Canadian demand. It also followed a world trend as world exports of wheat and coarse grains set a new record, reaching 204 million tonnes in 1981-1982 versus 199 million in 1980-1981.

Other Feeds

Canada's exports of feed, a mixture of forage crops such as hay and alfalfa, coarse grain products and oilseed products, grew from 506,000 tonnes in 1972 to 620,000 tonnes in

1980. A decline to 555,000 tonnes, valued at $5.7 million occurred in 1981. Feed exports were composed of 34% wheat bran shorts, 26% dehydrated alfalfa, 13% hay and clover, 8% glutten feed and 8% rapeseed screenings. Six other feeds make up the remaining 11%. Feed exports for the 10 year period 1972 to 1981 are shown in Appendix 9.

Feed imports have varied from year to year, from a volume of 107,000 tonnes in 1972 to 138,000 tonnes, valued at $13.8 million, in 1981. Hay, forage and straw accounted for 80% of this total, followed by feed concentrates and complete feeds, (18%), and dairy and cattle feeds (2%). Appendix 10 shows the imports of feed from 1972 to 1981. Canada has an export surplus of feeds, of the order of 400,000 tonnes annually.

The consumption of grains for reporcessing by the Canadian feed industry has increased in volume from 3.8 million tonnes in 1971 to 5.4 million tonnes in 1980, an average annual increase of 4%. The value of consumption has increased in the period by 297% to $804 million in 1980. The grain products most consumed by the industry in 1980 were corn (31% of the tonage), barley (28%), and wheat (16%). The value of these three products comprised 75% of the total value of the consumption of feed grains. A complete list of grain products with the production for the years 1971 to 1980 can be found in Appendix 11.

Shipments of the feed industry rose from 4.8 million tonnes in 1971 to 7 million tonnes in 1980. The value of shipments rose 377% from 147 million to $1,573 million during the same period, with complete feeds, at a value of $1,452 million, comprising the largest component. Shipments of waste and dockage tonnages during the 1980-1981 season amounted to 16,000 tonnes and the proportion moved was barley 36%, corn 31%, oats 18%, wheat 13%, flaxseed 1% and rapeseed 1%. Appendices 13 and 14 illustrate the shipments of the feed industry by commodity.

Alberta shipments of feed grain products have had an annual value of approximately double that of B.C. In 1978, B.C. shipped 187,000 tonnes, worth $26 million, while Alberta shipped 527,000 tonnes, worth $57 million. The value of shipments has increased in B.C. by 9% and Alberta 18% annually over the period 1973 to 1978.

TABLE 127

PRODUCTS SHIPPED BY B.C. AND ALBERTA PRODUCERS

	1973				1974				1975			
	B.C.		Alberta		B.C.		Alberta		B.C.		Alberta	
	tonnes	$(000)	tonnes	$(000)	tonnes	$(000)	tonnes	$(000)	tonnes	$(000)	tonnes	$(000)
Cereal Grain Chopped Inc. Mixed	21,779	1,966	34,629	2,962	15,035	2,075	31,925	3,984	18,288	2,617	25,588	3,514
Legumes and Grass Meal Dehydrated	-	-	48,401	2,764	-	-	49,962	4,354	-	-	73,847	5,907
Complete Feed Dairy Cattle	131,115	13,606	40,665	4,570	133,097	20,376	56,830	7,860	142,417	21,906	589,596	86,113
Complete Feed Beef Cattle	26,927	2,405	250,669	19,448	15,545	2,137	347,640	38,546	14,673	2,276	369,893	48,207
Total	179,821	17,977	374,364	29,744	163,677	24,588	486,357	54,744	175,378	26,799	1,058,924	143,741

	1976				1977				1978			
	B.C.		Alberta		B.C.		Alberta		B.C.		Alberta	
	tonnes	$(000)	tonnes	$(000)	tonnes	$(000)	tonnes	$(000)	tonnes	$(000)	tonnes	$(000)
Cereal Grain Chopped Inc. Mixed	20,140	2,606	21,500	2,620	12,506	1,747	22,345	2,211	17,673	2,245	48,696	4,673
Legumes & Grass Meal Dehydrated	-	-	81,393	6,283	-	-	134,604	11,510	-	-	107,507	8,882
Complete Feed Dairy Cattle	138,226	21,607	47,813	7,800	136,046	22,126	63,125	8,127	169,174	23,969	69,917	12,937
Complete Feed Beef Cattle	10,405	1,503	274,637	33,925	8,424	1,205	290,974	30,434			300,990	30,963
Total	168,771	25,716	425,343	50,628	156,976	25,078	510,048	52,282	186,847	26,214	527,110	57,455

Source: Statistics Canada

Selection of Probable Markets for Aspen-Based Feeds

Potential markets for semi-processed aspen fibre feeds, i.e., the Mukka type or Pro-Cell, relate directly to the availability and price of grains, concentrates and mixes in the marketing region selected. The other factors are, of course, a demand for human food produced in the region from an animal population. Canada, the United States and Europe are large consumers of meats, while in Asia the meat demand is diminished by the extensive consumption of rice.

The SCP market concept follows the above pattern but the product is conceived to be a supplement to other feeds, rather than as a replacement of part of the total volume consumed, such as in Mukka and Pro-Cell.

In general, it appears that the only potential markets for aspen-based animal feed products are in Canada, the U.S. and Asia. These national markets are, however, highly regionalized, based on the supply of basic feeds within a relatively localized area.

"Pro-Cell and Mukka"

The cost of transportation limits the availability of markets for products with a low value to unit weight ratio. Pro-Cell and Mukka can be equated to the lowest priced animal feed such as brome alfalfa and hay, as the end-use for these products is as an extender to be used in mixtures with standard grain feeds for ruminants such as cattle and sheep.

A spokesman for Pro-Cell specified the following conditions for a Stake Technology Limited, aspen-based, feed mill to be profitable in Canada. The first is control of the timber and the second is that there should be 250,000 cattle within a 160 kilometre radius of the plant, unless the plant is producing to a captive market.

Stake Technology has formed partnerships in two commercial plants, one in Minnesota and one in Florida. They are in partnership with the Apache Corporation in Minnesota to produce 50,000 tonnes of feed from aspen as raw material. In Florida they are in partnership with M. Golodetz and Company in a plant which has been producing 40,000 tonnes of cattle feed using bagasse as feedstock.

Pro-Cell has been tested on ruminants in Canada and the U.S. with inconclusive results. Test by feed lot operators in Alberta, using material from Stake Technology, found that Pro-Cell has a Total Digestible Nutrient (TDN) percentage of 30% and available crude protein percentage of 2 to 3%. The Pro-Cell official in the area maintains that the TDN is 58%. The comparable TDN for alfalfa hay is 45% and corn, 70%, with crude protein about 15 to 20% for both products.

Mukka, has been restricted to markets in the U.S.S.R. primarily and, as noted, will require extensive testing before an evaluation of its potential in other markets can be made.

SCP

The use of SCP is foreseen by its proponents as a protein supplement to other feeds for animals which, besides cattle and sheep, include hogs,poultry and domestic animals. SCP also has some potential as a protein supplement for human consumption, but this is, as previously noted, only in the very early stages of research.

The ITT Rayonier SCP plant in Port Angeles, Washington producing 16,000 tonnes of SCP per annum, appears to have problems in producing a consistent output.

The ICI plant, in the U.K. is successfully marketing SCP in Holland and Denmark for poultry and hog feed but has been unable to penetrate its own domestic market due to non-acceptance by local blenders and difficulties in meeting U.K. animal feed (Health) regulations.

Both Europeans and Japanese have developed feed mixes for their prime herds of cattle in a highly scientific manner over a great many years. They have indicated that they will require a great deal of evidence that a substitute product like SCP would meet their technical requirements before they would consider changing from their customary feed ingredients, regardless of price. Further, the Japanese market may be difficult to penetrate as they have reportedly developed a technique of producing quality feed for ruminant animals from hardwood chips, with commercial production to be started in the near future.

A great deal more research, testing and feeding trials will have to be carried out before SCP and Pro-Cell can be adequately compared to grain and soybean equivalents and before standards and markets can be established.

Competitive Products

As has been mentioned previously, hay and brome alfalfa would be the major competitive products of Pro-Cell in Canada. However, a number of others, such as chopped corn, might be considered depending on local circumstances. The prime competitive product for SCP is, and is likely to remain, soylecithin.

In all countries visited in Southeast Asia there was an extensive feed manufacturing industry in operation. The ingredients, corn, wheat, bran, etc., are imported in bulk form and mixed in varying proportions in processing plants within the country. Generally the companies engaged in this business and the government research departments were unconvinced that hydolyzed poplar fibre could ever be imported and marketed competitively. They were non-committal regarding SCP since it was virtually unknown other than through agricultural research agencies who read the published reports.

The consensus appears to be that Pro-Cell and SCP processes will be employed to convert locally available fibre in a specific region if the demand for feed supplements is sufficiently large.

It may be noted that restrictions on importation of pre-mixed or processed feeds apply in some countries. South Korea bans such imports.

Distribution Mechanics

Distribution would have to be set up using the same marketing channels used by the feed industry, i.e., producer to distributor to feed agent (retail or co-operative) for the North American markets, and agency distributorship for foreign markets.

Transportation Condsiderations

Transportation of any poplar based or derived feed product would be by "normal" transport means within North American, as well as offshore; i.e., truck and rail transportation to domestic markets and ports of shipment and vessel shipment to offshore areas.

Price Relationships

The selling price of Pro-Cell feed extender (quoted by a Pro-Cell spokesman for Alberta) was $102.30 per tonne, fob plant (1983). This compares and competes with the 1983 average price for hay and clover exports of $72.00 per tonne, as well as a price paid to producers for #2 feed oats and #1 feed barley (both superior products) of $125.22 and $106.55 respectively per tonne. Until such time as commercial production and sale is undertaken, actual prices may not be forecast. However, for reference purposes, Appendix 15 of this study contains the prices paid for feed grain products (wheat, oats and barley) for crop sales years 1970/71 to 1980/81.

The selling price for SCP produced in the pilot plant operation in Vancouver (Envirocon) has been estimated to be $300 per tonne and this would be in direct competition with imported oilcake and meal at $307 and soybean at $308 per tonne at 1981 prices. The prices estimated for the pilot plant are based on SCP produced from pulpmill waste and it is most probable that the cost of production directly from poplar trees would be much higher. It should also be noted that Envirocon have stated the intention to sell the technology and system for production, rather than the product, and that prices estimated have yet to be confirmed.

Trade Inhibitors

Tariffs

Since neither Pro-Cell nor SCP have been exported to other countries, no opinion can be obtained as to which tariff classification they would be dutiable. They may be classified as feed stuffs, chemicals or wood products, depending on the country of destination and exporters statement of raw material sources. Further, depending on the need of the importing country and competition with national products, duties could be assessed at a minimum or maximum level.

Non-Tariff Barriers

Both products (SCP and Pro-Cell) will require approvals from the Department of Agriculture (Canada), as well as food and drug authorities in immporting countries before they will be allowed entry in foreign countries. In the U.S., approvals will be required on an individual state basis if they are to be used as animal feed supplements or admixtures.

Future Demand

The projected world grain production, consumption and trade are shown in Table 128.

TABLE 128 SUMMARY OF PROJECTED WORLD GRAIN PRODUCTION, CONSUMPTION, AND TRADE*

(million tonnes)

	Average 1978-79	Projections 1985	Projections 1990
World Production			
Coarse Grains	740	852	943
Wheat	433	485	535
Rice	380	435	475
Total	1,553	1,772	1,953
World Consumption			
Coarse Grains	739	852	943
Wheat	431	485	535
Rice	380	435	475
Total	1,550	1,772	1,953
World Trade**			
Coarse Grains	95	110	125
Wheat	76	88	100
Total	171	198	225
U.S. Exports			
Coarse Grains	70	80	95
% World Trade	74%	73%	76%
Wheat	31	38	46
% World Trade	41%	43%	46%

*Crop year beginning July 1.

**World rice trade is relatively small, about 8 million tonnes a year, and is not expected to grow very rapidly in the next decade.

Source: Historical data, USDA, Foreign Agricultural Service; projections, Schnittker Associates.

World production and consumption of coarse grains and wheat is expected to continue to grow, but not uniformly among countries or regions. As a result, world grain trade is expected to continue to increase rapidly over the next decade, at annual rates of 2.4 and 2.5% for coarse grains and wheat respectively. While this implies greater potential for Pro-Cell in the future, until such time as use and acceptance are established, no future market potential can be inferred.

Production of soybeans is very likely to increase as the world population continues to grow and as larger numbers of people use soybean products as a source of protein. However, the rate of growth cannot accurately be projected. If SCP proves to be a useable replacement for soybean meal as an animal feed, with comparable standards, competitive price and market acceptance, it should share the growth of the soybean market for animal feed, with the added potential of human consumption, should it prove acceptable for.

Conclusions

Although both feed grains and soya products have large established and growing markets as animal feeds on both a domestic and export basis, there appears to be little evidence to indicate that any substantial portion of these markets can be captured by poplar-based animal feed products in the near future. On the contrary, the apparent cost and nutrient value of the fodder replacement products (Mukka and Pro-Cell) may in themselves be severe limitations to development of markets for these products, excepting for captive consumption or pilot type operations.

SCP does present some potential on a long-term basis, once economic and standards acceptance problems have been resolved.

Recommendations

Until further development work is done on Pro-Cell and SCP, and much more information on them is available, they cannot be seriously considered as marketable products that can be derived from poplar wood in the near future.

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32-214	Feed Industry
35-001	Construction Type Plywood
35-002	Production, Shipments, Stocks in Sawmills East of the Rockies
35-003	Production, Shipments, Stocks in Sawmills in B.C.
35-204	Sawmills, Planing Mills and Shingle Mills
35-205	Sash, Door and Other Millwork Plants
35-206	Veneer and Plywood Plants
35-208	Miscellaneous Wood Industries
35-211	Household Furniture Manufacturers
35-212	Office Furniture Manufacturers
35-213	Miscellaneous Furniture and Fixtures Manufacturers
36-001	Hardboard
36-002	Rigid Insulating Board
36-003	Particleboard, Waferboard, Hardboard
36-004	Corrugated Boxes and Wrappers
36-204	Pulp and Paper Mills
36-206	Miscellaneous Paper Converters
36-207	Paper and Plastic Bag Manufacturers
36-214	Folding Carton and Set-up Box Manufacturers
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65-004	Domestic Exports by Commodities
65-006	Imports by Countries
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APPENDIX I

ABBREVIATIONS AND DEFINITIONS

ABBREVIATIONS AND DEFINITIONS

APL	Alberta Power Limited
ACSR	"Aluminum Conductor Steel Reinforced" Power Cables
ANPA	American Newspaper Publishers Association
API	American Paper Institute
AFNOR	Association Francais Pour Normalisation
BPA	Bonneville Power Authority
B.C.	British Columbia
BCH	British Columbia Hydro and Power Authority
CD	Calender Days
CDX	Exterior Sheathing Plywood - U.S. Grade Terminology
CHMC	Canada Housing and Mortgage Corporation
CIP	Canadian International Paper Ltd.
CPPA	Canadian Pulp and Paper Association
CSP	Canadian Softwood Plywood
CSF	Canadian Standard Freeness
CSA	Canadian Standards Association
CHI	Carroll-Hatch (International) Ltd.
CMP	Chemi-mechanical Pulp
C.I.F./cif	Cost Including Insurance and Freight
CIC	Crown Investments Corporation of Saskatchewan
cum	cubic metres
DRI	Data Resources Inc.
DIN	Deutsche Industrie Normen (W. Germany)

DIY	Do It Yourself
ECP	Edmonton City Power
EEMA	Electrical Energy Marketing Agency; (Alberta)
ERCB	Energy Resources Conservation Board; (Alberta)
EEC	European Economic Community
EFTA	European Free Trade Area
FAO	Food and Agricultural Organization of the United Nations
FAO/IWP	Food and Agricultural Organization/Industry Working Party
FAS	Free Along Side
fbm	foot board measure
FMT	Finished Metric Ton
GATT	General Agreement on Tariff and Trade
g/cc	grams per cubic centimetre
GDP	Gross Domestic Product
GNP	Gross National Product
gsm	grams per square metre
IMF	International Monetary Fund
km	Kilometre
kVa	Kilo-Volt-Amps (apparent power)
kWh	Kilowatt Hours (Consumption)
LVL	Laminated Veneer Lumber
M.D. Charge	Maximum Demand Charge
MDF	Medium-Density Fibreboard
mW	Megawatts (Power)
Mt	Million tonnes
n/a	not available

nes	not elsewhere specified
NORSCAN	The United States, Canada, Sweden, Norway, Finland
n.o.p.	not otherwise provided for
NTIS	National Technical Information Service (Washington, D.C.)
OECD	Organization for Economic Cooperation and Development
OEM	Original Equipment Manufacturer
OSB	Oriented Strand Board
PB	Particleboard
PUB	Public Utilities Board; (Alberta)
PUC	Public Utilities Commission; (B.C.)
PURPA	Public Utilities Regulatory Policy Act (U.S.)
Q	Quarter
RMP	Refiner Mechanical Pulp
SCP	Single Cell Protein
S/C	Supercalendered
SGW	Stone Groundwood Pulp
sm	Square Metre
SPF	Spruce/Pine/Fir
SRI	Stanford Research Institute
SWE	Solid Wood Equivalent
S2S	Surfaced two sides
t	metric tonne
TDN	Totally Digestible Nutrient
TMP	Thermomechanical Pulp
tpa	metric tons per annum
TUC	Transalta Utilities Corporation

U.N.	United Nations
U.S.	United States
USDA	United States Department of Agriculture
WB	Waferboard
WFPL	Western Forest Products Laboratory

MONETARY UNITS	US$	United States Dollar
	C$	Canadian Dollar
	S$	Singapore Dollar
	HK$	Hong Kong Dollar
	NT$	New Taiwan Dollar

APPENDIX 2

USE OF THE POPLAR RESOURCES
FOR PULP AND PAPER PRODUCTS

APPENDIX 2 - USE OF THE POPLAR RESOURCE FOR PULP AND PAPER PRODUCTS*

Summary

Aspen, balsam poplar and black cottonwood can be used successfully in a wide range of pulp and paper products. Aspen, in particular, is a preferred species amongst hardwoods for many products. A summary of the technical feasibility of various pulp grades is given in Table 129.

The technical feasibility of utilizing specific poplar resources is dependent on the quality of the resource. Significant quantities of rot and/or stain can make utilization impractical. The various categories of pulp grades are discussed below.

Bleached Kraft

Bleached hardwood kraft pulps are of importance to the paper maker since they impart the properties of softness, bulk, opacity, good formation and good printability. The hardwood pulp itself has some advantages in the pulp processing such as relatively easy cooking and high yield. In comparison with softwood pulps, the hardwoods are easy beating but are of low strength. The strength properties are approximately 60-80% of typical softwood properties but the desirable characteristics of hardwoods make them an important component of many paper products. The strength characteristics of aspen kraft pulp are compared with other pulps in Table 130.

Another important end use for bleached hardwood kraft is in bleached board where it can be used as the major component, together with a small quantity of softwood. An example of this is the large scale production of high quality bleached board from hardwoods by Westvaco Corporation in Covington, Virginia. Aspen would be a satisfactory hardwood for this end use and indeed, poplar is part of the furnish being utilized for such products.

Kraft hardwood paper grade pulp is produced in many countries. Typical examples of bleached hardwood kraft market pulp mills in Canada are the Thurso, Quebec mill of James MacLaren Industries Inc. and St. Anne-Nackawic Pulp & Paper Company Ltd., Nackawic, N.B. Many other Canadian kraft mills utilize hardwoods to some extent and aspen is a frequent component of the furnish. The production of a mixed hardwood/softwood grade has to be considered as a possibility. A typical example of a company marketing such a product is Eddy Forest Products, who produce a 50/50 grade. Consolidated Bathurst at Pontiac also produce mixed grades. Several mills produce fine papers from 100% hardwood kraft in the eastern U.S. International Paper is a good example of a company utilizing hardwood kraft pulps in this way. In the U.S.S.R., aspen kraft pulp is a frequent component of writing and other papers. Both cottonwood and aspen are considered good hardwoods for kraft pulp manufacture. Aspen in particular, is considered to produce a pulp which compares well with any other hardwood. In Europe, the hardwood kraft pulps are generally been considered to be in the following order of preference: birch, beech, eucalyptus and tropical hardwoods. Eucalyptus may now be higher. Aspen would be closely equivalent to the birch pulps, as shown by the comparison in Table 131. Since data on 100% aspen or cottonwood market pulps is not available from field samples, literature and Econotech data have been used to estimate the characteristics as noted at the bottom of the table. The work carried out in the evaluation of the hardwood resources for the O'Chiese block of Alberta shows that there is only a limited use for aspen if it has been subject to decay or is stained. Kraft market pulp containing approximately 50% cottonwood has been produced by Columbia Cellulose Company at Prince Rupert.

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*Prepared by: Dr. P.R. Thomas, Econotech Services Ltd., Vancouver

Kraft Liner

The potential for poplar utilization in the production of kraft linerboard is very poor due to strength considerations. Poplar could only be used at very low levels of incorporation.

Sack Kraft

Owing to the critical strength requirements of this product, hardwood is unsuitable as the major component. It can be utilized to a very minor extent as part of the furnish.

Corrugating Medium

Poplars are good raw material for this product. Hardwoods are very extensively used for corrugating medium production and indeed, are considered the best furnish. Usually a mixed hardwood furnish is used and aspen can be a major component. Corrugating medium is being produced extensively in North America from hardwoods. An example of such a mill in Canada is Lake Utopia Paper Limited owned by Irving Pulp & Paper in St. George, New Brunswick. Domtar is also a corrugating grade producer. Aspen produces an excellent corrugating medium. The first mill to use aspen for such a product was the American Box Board Company Mill at Filer City, Michigan, which is now owned by the Packaging Corporation of America. Some companies feel they produce the best product if at least 50% of the furnish is aspen. Poplar species are also used outside North America to produce corrugating medium, Hungary being a good example. It can be safely assumed that cottonwood could also be used for this product.

Mechanical Pulp

A large amount of research has been put into the production of mechanical pulp from hardwoods. This work has shown that CMP (chemi-mechanical pulp) is far superior to TMP (thermomechanical pulp). It also indicates that the pulp characteristics can be altered over a wide range, according to the severity of the chemical stage in the CMP process. At lower yields, superior strength characteristics are produced but this is at the expense of higher wood use per ton of pulp.

As noted above, the production of a mechanical pulp using thermomechanical processing from a medium density hardwood such as aspen is unsatisfactory relative to the strength of the product produced, although light scattering ability is satisfactory. The strength deficiencies are not only in the bonding strength category (burst and breaking) but also in tear strength due to the relatively short fibre length of the hardwoods. Use of the chemi-mechanical process to produce pulps in the yield range of 80-90% produces a hardwood CMP having good bonding properties equivalent to those of softwood. Such pulps have, however, reduced light scattering ability and lower brightness. As yield is increased, bonding strength is reduced. Table 130 indicates that aspen CMP can be produced at relatively high quality. Such a pulp, when bleached, can be used successfully in many printing and writing grades and has been used in trials at very high levels of incorporation in newsprint furnish with a great deal of success.

Bleached RMP aspen pulp can be used successfully for tissue and sanitary products. Bleached RMP or CMP aspen pulp can be used as a component of duplex or solid boards. In such end uses, it can replace waste paper where it is of better quality and produces a product of higher bulk which requires less fibre.

Poplar is being used in Spain for mechanical and chemi-mechanical pulp. Aspen is being used in small quantities in mechanical pulp mills of the north central U.S., although no specific information is available. Scott Paper Limited of New Westminster, B.C. is using cottonwood and a small quantity of aspen in the production of refiner mechanical pulp for use in tissue and other products. It appears that cottonwood producers a mechanical pulp of similar strength characteristics to aspen.

Bleached Sulphite

Both aspen and cottonwood can be used satisfactorily in the production of bleached sulphite paper pulp. Cottonwood bleached sulphite was produced by Columbia Cellulose at Prince Rupert. Sulphite pulps from hardwoods are of lower strength than the corresponding kraft pulps (approximately 20% lower). Consequently, the marketability of conventional sulphite hardwood pulps is questionable but regional considerations have resulted in such pulps being produced, notably in Europe. Sulphite paper grade hardwood pulps are available. An example of such pulp would be the 100% beech bleached market sulphite hardwood pulp produced by Schwabische AG, West Germany. A comparison of hardwood sulphite pulps is given in Table 132.

Dissolving Pulp

Hardwoods can be and, in fact, are being used very successfully in the production of dissolving pulps. Both acetate and viscose type pulps are used in North America and abroad. In North America, International Paper have been making high quality acetate grade for many years. One of their best known pulps is Acetakraft, which is a prehydrolyzed kraft pulp produced from poplar and gums in the southeastern U.S. It is a high purity pulp and has undergone cold caustic treatment. It is used to produce secondary acetate fibres. When International Paper owned the Temiscaming, Quebec, sulphite mill, they produced acetate pulp from Canadian hardwoods. For example, their grade called I.P. Hardwood Sulphite was used to produce secondary acetate fibres. The I.P. pulps show excellent filterability characteristics, good colour and haze. I.P. have also included Canadian poplar in the furnish used to make plastics-grade pulp. The lower mannan content of hardwood pulps is considered an advantage in the preparation of acetate pulp.

The Buckeye Cellulose Corporation also produce a pulp for the production of secondary acetate fibres from a mixture of gum, beech and poplar. They also produce a plastics-grade pulp from a mixture of different hardwood species.

Cottonwood has been used to make acetate pulp by Columbia Cellulose Company. Cottonwood can be used to manufacture high quality acetate pulp by either hot or cold caustic processes. A yield advantage, equivalent to a 12% reduction in wood usage, relative to softwoods, are indicated.

Hardwoods are also a satisfactory raw material for the production of rayon viscose pulps to be converted into cellophane, filament or staple fibre. Tembec are currently producing such pulps in Canada, principally from maple and poplar residual material. International Paper at Hawkesbury also produced pulps of this type but this mill has recently announced a closure, mainly because it was heavily involved in the manufacture of pulps for cellophane, the market for which has shown a steady decline.

As noted above, aspen is being used in Canada for the production of dissolving pulp. Prehydrolysis kraft pulp from aspen is produced in Russia for acetylation. The markets for Canadian dissolving pulps produced from hardwood are principally in Japan, the U.S. and Europe. One very important potential market is China and there have been indications, recently, that the Chinese are considering a major expansion in cellulosics production.

TABLE 129 SUMMARY OF TECHNICAL FEASIBILITY OF PULP GRADES MANUFACTURED FROM ASPEN/COTTONWOOD

Bleached Kraft - Good

Pulp quality is towards the top of the range compared to other hardwood species. Can be used as a significant component of most paper grades. Can be used as a major component of bleached board.

Kraft Liner - Poor

Strength too low for anything other than a very minor component.

Sack Kraft - Poor

Strength too low for anything other than a very minor component.

Corrugating Medium - Good

Aspen is known to produce good quality medium.

Mechanical Pulp - Good

Bleached RMP can be used successfully for tissue and sanitary products. RMP or CMP can be used as a component of duplex or solid boards. Bleached CMP can be used as a major component of newsprint. Aspen is a preferred species for hardwood mechanical pulp.

Bleached Sulphite - Good

Aspen and cottonwood produce a good bleached sulphite grade with relatively high strength compared with many other hardwoods.

Dissolving Pulp - Good

High quality acetate and viscose pulps can be produced by the prehydrolysed kraft or sulphite processes.

TABLE 130 STRENGTH COMPARISON OF ASPEN KRAFT AND CMP WITH SOFTWOOD PULPS

(Typical Data Expressed as % of Softwood Kraft at 300 CSF)

	Softwood Kraft		Aspen			Softwood				
			Kraft	CMP High Yield	CMP Low Yield	CMP High Yield	TMP	Saw-dust SGW	Chips SGW	Saw-dust CMP
CSF	300	680	300	105	150	320	110	78	69	50
Burst Index	100	55	60	26	43	45	21	14	15	18
Breaking Length	100	62	77	34	52	44	30	23	24	26
Tear Index	100	173	79	51	51	74	93	41	44	35

CMP = Chemi-mechanical Pulp

TMP = Thermomechanical Pulp

SGW = Stone Groundwood Pulp

CSF = Canadian Standard Freeness

TABLE 131

COMPARISON OF HARDWOOD KRAFT PULPS

Data at 400 CSF

	Valley Beating Time	PFI Revs	Burst Factor	Tear Factor	Tensile Km	Bulk cc/gm	Opacity %
100% Birch (Canada)*	-	2200	64	99	9.9	1.3-1.6	70-75
100% Aspen (Canada)*	-	1-2000	44-55	66-90	6.6-8.6	1.4-1.6	75
100% Cottonwood (Canada)*	-	1900	48	91	8.0	1.3-1.6	75
50% Poplar, 40% other Hardwood, 10% Softwood (Canada)	12	-	22	58	4.5	1.67	74
100% Eucalyptus (Europe)	42	-	45	110	7.5	1.63	78
100% Mixed Hardwood (Europe)	23	-	31	76	5.7	1.64	80
84% Birch, 16% Poplar (Europe)	29	-	50	95	8.1	1.48	77
Eucalyptus + other Hardwood (Japan)	37	-	24	70	5.3	1.64	81
73% Birch, 27% Aspen (Europe)	19	-	40	79	7.4	1.44	76
100% Birch (Europe)	-	1500	49	84	8.0	1.44	72.5
100% Birch (Europe)	-	900	38	84	6.7	1.56	76.0
100% Hardwood (Japan)	28	-	31	77	5.9	1.57	78.5
100% Eucalyptus (Europe)	-	1100	38	118	6.7	1.60	80.0
95% Birch, 5% Spruce (Europe)	31	-	52	97	9.6	1.46	78
50% Cottonwood, 50% Softwood (Canada)	32	-	68	110	10.0	1.49	73
100% East. U.S. Hardwoods	36	-	28	82	5.4	1.72	78
96% East. Canada Hardwoods incl., 30% Aspen, 4% Spruce	15	-	39	79	5.7	1.65	78
60% Cottonwood 40% Softwood,(East. Canada)	19	-	56	100	8.8	1.45	76.5
100% European Hardwood, incl., 70% Beech, 17% Birch	23	-	31	76	5.7	1.64	80
100% Birch (Europe)	22	-	41	92	7.2	1.46	73
100% Hardwood (Maine, U.S.)	15	-	28	85	5.2	1.73	79.5
100% Hardwood (S.E. U.S.)	15	-	39	113	7.2	1.65	69.5
84% Birch, 16% Poplar (Europe)	29	-	50	95	8.1	1.48	77
76% Alder, 9% Cottonwood, 15% Softwood (Western U.S.)	32	-	38	102	6.8	1.56	77
100% Alder (Western U.S.)	-	3400	46	110	7.5	-	76

NOTE: All data is from mill market pulps except those marked *.
This * data is from pilot plant pulps where strength data has been adjusted down by 20% for burst and tensile and 5% for tear.

TABLE 132

COMPARISON OF HARDWOOD SULPHITE PULPS

	Valley Beating Time	PFI Revs	Burst Factor	Tear Factor	Tensile Km	Bulk cc/gm	Opacity %
84% Aspen, 9% Birch (Europe)	15	-	27	86	5.7	1.63	77
100% Beech (Europe)	24	-	27	60	5.8	1.68	82
100% Eucalyptus	25	-	11	31	3.3	1.71	85
100% Beech (Europe)	16	-	13	52	3.4	1.63	81
100% Dense Hardwood (N. Central U.S.)	-	100	15	30	3.9	-	83

APPENDIX 3

DATA ON NEWSPRINT AND PRINTING/WRITING PAPERS

TABLE 133

UNITED STATES
APPARENT CONSUMPTION OF NEWSPRINT, 1960-1981

(thousand tonnes)

1960	6,316
61	6,277
62	6,368
63	6,419
64	6,839
1965	7,272
66	7,785
67	7,856
68	7,932
69	8,381
1970	8,273
71	8,391
72	9,018
73	9,251
74	9,166
1975	8,322
76	8,688
77	9,279
78	9,881
79	10,205
1980	10,134
81	10,164
82	10,115

Source: ANPA, API, Sandwell

Note: Tonnage data adjusted to 48.8 gsm

TABLE 134 UNITED STATES
DESTINATION OF NEWSPRINT SHIPMENTS FROM CANADA, 1980

	Volume (thousand tonnes)	Percent of Total (%)
Northeast	2,017	33.0
Maine, New Hampshire, Vermont		0.8
Connecticut, Massachussets, Rhode Island		6.5
New Jersey, New York, Pennsylvania		25.7
Midwest	2,128	34.8
Michigan, Ohio		13.7
Illinois, Indiana, Wisconsin		14.2
Minnesota, North Dakota, South Dakota		2.8
Iowa, Kansas, Missouri, Nebraska		4.1
South	882	14.4
Delaware, Maryland, District of Columbia, North Carolina, Virginia, West Virginia		6.5
Florida, Georgia, South Carolina		4.4
Kentucky, Tennessee		2.0
Alabama, Mississippi		0.1
Arkansas, Louisiana		0.1
Oklahoma, Texas		1.3
West	1,091	17.8
Idaho, Montana, Wyoming		0.5
Arizona, New Mexico		0.7
Colorado, Nevada, Utah		2.2
Alaska, Oregon, Washington		2.8
California, Hawaii		11.6
Total	6,118	100.0

Source: CPPA, Sandwell

TABLE 135

CANADA

APPARENT CONSUMPTION OF NEWSPRINT, 1960-81

(thousand tonnes)

1960	414
61	418
62	435
63	444
64	468
1965	502
66	527
67	543
68	573
69	603
1970	610
71	615
72	668
73	736
74	804
1975	784
76	803
77	825
78	924
79	971
1980	980
81	1,040
82	935

Source: CPPA, Sandwell

Note: Tonnage data adjusted to 48.8 gsm

TABLE 136

UNITED STATES
NEWSPRINT CAPACITY BY REGION & MILL

(thousand tonnes)

	1980	1981
Northeast		
Garden State Paper - Garfield, New Jersey	181	186
Great Northern Paper - East Millinocket, Maine	295	295
	476	481
Midwest		
Manistique Pulp & Paper - Manistique, Michigan	30	30
FSC Paper Corp., - Alsip, Illinois	100	103
	130	133
South		
Abitibi Southern Corp., - Augusta, Georgia	144	144
Bear Island Paper - Doswell, Virginia	106	154
Boise-Price Southern Newsprint - De Ridder, Louisiana	230	321
Bowater Southern Paper - Calhoun, Tennessee	577	611
Catawba Newsprint - Catawba, South Carolina	198	200
International Paper - Mobile, Alabama	110	110
International Paper - Pine Bluff, Arkansas	158	158
Kimberly-Clark, Coosa Pines, Alabama	381	381
Southeast Paper - Dublin, Georgia	154	154
Southland Paper (Div. St. Regis) - Houston, Texas	283	387
Southland Paper (Div. St. Regis) - Lufkin, Texas	308	293
	2,649	2,913
West		
Boise Cascade - Stelacoom, Washington	161	161
Crown Zellerbach - Port Angeles, Washington	34	34
Crown Zellerbach - Wauna, Oregon	120	120
Garden State Paper - Pomona, California	98	90
Inland Empire Paper - Millwood, Washington	45	49
North Pacific Paper - Longview, Washington	190	286
Publishers Paper - Oregon City, Oregon	210	211
Publishers Paper - Newberg, Oregon	146	277
Southwest Forest Industries - Snowflake, Arizona	144	144
	1,148	1,372
Total U.S. Capacity	4,403	4,899

Source: API, ANPA

TABLE 137

CANADA
NEWSPRINT CAPACITY BY PROVINCE & MILL

(thousand tonnes)

	1980	1981
British Columbia		
B.C. Forest Products - Crofton	263	273
Crown Zellerbach - Elk Falls	252	252
MacMillan Bloedel - Port Alberni	371	376
MacMillan Bloedel - Powell River	434	520
Ocean Falls Corporation - Ocean Falls	32	-
	1,352	1,421
Manitoba		
Abitibi-Price - Pine Falls	163	165
New Brunswick		
Canadian International Paper (CIP) - Dalhousie	261	260
Irving (M-B Rothesay) - St. John	303	310
	564	570
Newfoundland		
Abitibi-Price - Grand Falls	263	265
Abitibi-Price - Stephenville	-	96
Bowater Newfoundland Ltd. - Corner Brook	351	362
	614	723
Nova Scotia		
Bowater Mersey Paper Company - Liverpool	159	161
Nova Scotia Forest Industries - Port Hawksbury	148	153
	307	314

	1980	1981
Ontario		
Abitibi-Price - Fort William	118	112
Abitibi-Price - Iroquois Falls	289	293
Abitibi-Price - Sault Ste. Marie	88	84
Abitibi-Price - Thunder Bay	146	148
Boise Cascade - Kenora	211	220
Domtar - Red Rock	66	67
Great Lakes Forest Products - Thunder Bay	372	387
Ontario Paper - Thorold	220	218
Spruce Falls Power & Paper - Kapuskasing	312	310
	1,822	1,839
Quebec		
Abitibi-Price - Alma	259	265
Abitibi-Price - Beaupre	137	138
Abitibi-Price - Chandler	209	210
Abitibi-Price - Kenogami	160	169
Canadian International Paper (CIP) - Gatineau	470	497
Canadian International Paper (CIP) - Trois Rivieres	285	289
Consolidated Bathurst - Shawinigan Falls	332	335
Consolidated Bathurst - Grand Mere	224	225
Consolidated Bathurst - Port Alfred	305	319
Consolidated Bathurst - Trois Rivieres	68	71
Domtar - Donnacona	40	41
Domtar - Dolbeau	134	138
Donahue - Clermont	226	232
Kruger - Bromptonville	167	173
Kruger - Trois Riveres	238	237
J. Maclaren - Buckingham	154	160
Ontario Paper - Quebec North Shore Paper Company, Baie Comeau	417	418
Reed Limited - Quebec City	323	329
St. Raymond Paper - St. Raymond	2	1
F.F. Soucy - Riviere du-Loup	158	156
	4,308	4,403
Total Canadian Capacity	9,130	9,445

Source: CPPA

TABLE 138

CANADA
DISTRIBUTION OF OFFSHORE NEWSPRINT SHIPMENTS
(thousand tonnes)

Year	United Kingdom	Western Europe (excl.U.K.)	Latin America & Caribbean	Africa	Asia	Oceania	Total
1970	379	137	543	51	293	148	1,551
71	371	71	438	32	242	118	1,272
72	496	69	464	21	281	106	1,437
73	445	63	469	17	168	132	1,294
74	490	132	537	29	267	143	1,598
1975	382	131	455	8	180	90	1,246
76	466	147	464	26	213	112	1,428
77	461	168	597	35	245	87	1,594
78	491	189	476	11	289	91	1,546
79	398	187	445	7	292	108	1,437
1980	442	181	518	5	267	111	1,524

Source: CPPA

TABLE 139

CANADA
NEWSPRINT PRICE INDEX FOR DOMESTIC SALES
(1971=100)

Year	1 Q	2 Q	3 Q	4 Q	Annual Average
1965	85.3	85.3	85.3	84.6	85.1
1966	83.7	84.5	87.4	87.4	85.8
1967	87.4	87.5	89.5	89.4	88.4
1968	89.4	89.4	89.5	89.5	89.5
1969	92.6	92.6	92.5	92.4	92.5
1970	95.0	94.9	94.8	94.8	94.9
1971	95.2	100.3	100.3	104.2	100.0
1972	106.2	106.3	106.3	106.0	106.2
1973	107.0	107.4	109.5	113.4	109.3
1974	127.8	129.1	139.9	146.5	135.8
1975	160.4	160.4	160.2	160.0	160.2
1976	164.9	176.8	177.4	181.5	175.2
1977	190.0	190.0	189.9	189.5	189.8
1978	189.7	201.7	201.9	201.8	198.8
1979	213.7	221.2	220.8	241.8	224.4
1980	245.3	257.1	263.4	265.8	257.9
1981	282.1	282.4	294.3	301.8	290.1
1982	310.0	322.8	322.6		

Source: Statistics Canada.

Note: Price Index based on mill net prices in Canadian dollars.
Q = quarter

TABLE 140

CANADA
NEWSPRINT PRICE INDEX FOR EXPORT SALES
(1971=100)

Year	1 Q	2 Q	3 Q	4 Q	Annual Average
1965	92.1	92.2	92.2	91.8	92.1
1966	92.0	93.3	95.9	96.4	94.4
1967	96.3	96.6	98.2	97.9	97.3
1968	98.8	98.1	97.3	97.2	97.9
1969	101.0	101.2	101.5	100.8	101.1
1970	103.8	102.4	98.7	98.1	100.8
1971	97.1	101.3	101.4	100.2	100.0
1972	103.4	102.8	102.3	102.7	102.8
1973	104.7	106.8	110.2	115.8	109.4
1974	125.0	127.6	145.6	148.6	136.7
1975	169.4	173.6	174.0	171.8	172.2
1976	170.4	175.3	179.7	185.0	177.6
1977	202.3	207.9	212.2	219.3	210.4
1978	221.0	236.7	239.3	248.7	236.4
1979	260.5	262.8	264.8	283.9	268.0
1980	286.4	299.5	302.1	312.9	300.2
1981	332.6	334.5	350.7	352.9	342.7
1982	357.3	368.8	367.1		

Source: Statistics Canada.

Note: Price Index based on mill net prices in Canadian dollars.
Q: Quarter.

TABLE 141 PRINCIPAL GRADES OF PRINTING AND WRITING PAPER*

	Basic Size	Typical Basis Weight	
Coated		lb/500 Sheets	gsm Equivalent
Free, Grade Level 1	25 x 38	80-100	118-148
Free, Grade Level 2	25 x 38	70-100	104-148
Free, Grade Level 3	25 x 38	60-100	89-148
Mechanical, Grade Level 4	25 x 38	45-80	67-118
Mechanical, Grade Level 5	25 x 38	32-80	47-118
Uncoated			
Free, Offset, M.F., E.F., S/C, Text	25 x 38	30-120	44-178
Free Cover	20 x 26	50-100	135-270
Free Envelope	17 x 22	16-40	60-150
Free Tablet	17 x 22	15-20	56-75
Free Bond	17 x 22	13-24	49-90
Free Form Bond	17 x 22	10-28	38-105
Free Ledger	17 x 22	24-36	90-135
Free Mimeo	17 x 22	16-24	60-90
Free Duplicator	17 x 22	16-20	60-75
Free Manifold	17 x 22	7-9	26-34
Free Thin	17 x 22	9-40	34-150
Free Cotton Fibre	17 x 22	13-28	49-105
Mechanical, Book	25 x 38	30-45	44-67
Solid Bleached Bristols			
Tabulating	24 x 36	99	161
Tag	24 x 36	100-270	163-440
Index Bristol	25 1/2 x 30 1/2	90-140	163-253
File Folder	24 x 36	100-225	163-366
Printing Bristol	22 1/2 x 35	110-225	196-402
Postcard	.008" - .011"	thickness	
Coated Bristol	24 x 36	100-170	163-277
Other			
Cigarette	25 x 38	under 20 lb.	under 30
Condenser	25 x 38	under 20 lb.	under 30
Lens	25 x 38	under 20 lb.	under 30
Tea Bag	25 x 38	under 20 lb.	under 30

*Grades designated "free" contain less than 10% mechanical pulp; grades designated "mechanical" contain 10% or more mechanical pulp.

Sources: Pulp & Paper, May 1980; SRI

APPENDIX 4

PRIMARY PROCESSES TO BREAK DOWN WOOD INTO SIMPLER COMPOUNDS

APPENDIX 4

PRIMARY PROCESSES USED TO BREAK DOWN WOOD INTO SIMPLER COMPOUNDS

1. Pyrolysis and Gasification

This process consists of the destructive distillation of wood which is, on balance, endothermic. Pyrolysis is usually performed at atmospheric pressure with temperatures up to 2000°F and a controlled supply of oxygen. The high temperature and oxygen deficit results in a breakdown into three major components: wood gas composed of CO_2, CO, CH_4, C_2H_4 and H_2 etc., distillates of insoluble tar (phenolics) and pyroligenous acid containing acetic acid, methanol, acetone, esters, aldehydes, furfural and a solid phase of ash and char.

2. Hydrolysis

(a) Acid hydrolysis involves the steam heating of wood chips in a reactor. Acid and water are added to the vessel and allowed to percolate through the mass of chips. The reaction raises temperatures from approximately 150°C to 200°C and pressures from 400 to 1500 KPa. The hydrolyzate passes through the reactor removing sugars which have been formed. The hot hydrolyzate is flashed in two stages with methanol and furfural collected in the condensate. The hydrolyzate is neutralized with lime to a pH of 4.5 and the resulting gypsum separated from the sugar solution. The solution can be either crystallized or fermented. Celluloses will hydrolyze under mild conditions to form monosaccharides, mostly glucose. Cellulose will hydrolyze under stronger conditions to form hexoses.

(b) Enzymatic hydrolysis has the potential of higher sugar yields than acid hydrolysis because the enzyme is specific in its action. Preliminary treatment such as grinding or alkali treatment open up the lignin carbohydrate complex. The cellulose enzyme is produced; on a cellulose substrate with added nutrients. Pre-treated feed is slurred with water and treated with the enzyme for 48 hours and following which the sugar solution is separated. Reported yields are from 16-57%.

(c) Prehydrolysis or, partial hydrolysis, is a process during which the wood is steamed and acetic and formic acids are released from the hemicelluloses. These acids may be recycled to help catalyze the reaction. Hemicelluloses are substantially hydrolyzed to sugars leaving cellulose and lignin which can then be further processed.

High pressure steaming causes separation of the cellulose fibres from lignin so that the resulting material can be hydrolyzed more easily and the fibres can be digested to some extent by ruminants.

Source: Energy and Chemicals from Wood, Alberta, DENR.

APPENDIX 5

CHEMICAL PRODUCTS FROM POPLARS

APPENDIX 5

CHEMICAL PRODUCTS FROM POPLARS

A. From Hemicelluloses

Primary Products	Secondary Products	Tertiary Products	
I HYDROLYSIS	I FERMENTATION	I METHYLATION	
1. Glucose			
2. Mannose	1. Acetone	Acrylates	
3. Arabinose	2. Single Cell Protein (SCP)		
4. Galactose	3. Butanol		
5. Xylose			
	II HYDROGENATION	I HYDROGENATION	
	1. Xylitol	Sweeteners	
	III DEHYDRATION	I METHYLATION	
	1. Furfural	1. 2-Methyl furan	
		II DEHYDROGENATION	1. Tetrahydro furan
		2. Furan	2. Adiponitrile
			3. Nylon
		III NITROGENATION	
		3. Lysine	
		IV HYDRATION	
		4. Furfural Alcohol	1. Tetrahydro furfural alcohol

V CARBOXYLATION

5. Glutamic acid

VI CO-POLYMERIZATION

6. Polyurethane foams

VII CO-POLYMERIZATION

7. Resin & plastics

VIII NITROGENATION & HALOGENTATION

8. Nitrogenated halogenated derivatives

IX VARIOUS

Pharmaceuticals

B. From Cellulose

	Primary Products		Secondary Products		Tertiary Products
I	PARTIAL DELIGNIFICATION				
	1. Ruminant Feeds				
II	PULPING PROCESS				
	1. Dissolving Pulp	I	ESTERIFICATION		
			1. Cellulose Esters		
		II	DISULFIDE HYDRATION		
			2. Regenerated Cellulose		
		III	ALKYLATION		
			3. Cellulose Ethers		
III	HYDROLYIS				
	1. Glucose	I	FERMENTATION		
			1. Single Cell Protein (SCP)		
			2. Gluconic Acid		
			3. Glycerol		
			4. Xantham Gum		
			5. Itaconic Acid	I	HYDROXYLATION
			6. Acetone		1. Acrylates
			7. Lactic Acid		
			8. Ethanol	I	BLENDING
					2. Motor Fuels

9. Butanol

10. Butylene Glycol
11. Glycerol

IV DEHYDRATION
1. Hydroxy Methyl Furfural

V ISOMERIZATION
1. Glucose/Fructose Syrup

II ESTERIFICATION
3. Ether

III ACELATION
4. Acetaldehyde

IV HALOGENATION
5. Chloroform

V POLYMERIZATION
6. Polyurethane

VI DEHYDRATION
7. Butadiene

V VARIOUS
1. Nylon
2. Polyesters
3. Resins
4. Levulinic Acid

I PURIFICATION
1. Sweeteners

I DEHYDRATION
1. Butadiene

I VARIOUS
1. Plastics
2. Drugs

VI METHYLATION

1. Methyl Glucosides

VII HYDROGENATION

1. Sorbitol

I CO-POLYMERIZATION

1. Alkyd Resins
2. Surfactants

I VARIOUS

1. Sweeteners
2. Propylene Glycol
3. Humecants
4. Vitamins

C. From Lignin

Primary Products	Secondary Products	Tertiary Products
I EXTRACTION FROM PROCESS		
1. Solid Fuel		
2. Low Molecular Weight Phenols	I METHYLATION	I CO-POLYMERIZATION
	1. Phenolic Resins	1. Polyesters
3. Adhesives		
4. Road Stabilizers	I CO-POLYMERIZATION	
5. Drilling Mud Additives	2. Reinforced Rubber	
II PURIFICATION & EXTRACTION		
6. Vanillin		
7. Binders (inks & printing dyes) (slow release binders for herbicides and fertilizers		
III OXIDATION		
8. Activated Carbon		
IV FERMENTATION		
9. Methanol	I BIOLOGICAL CONVERSION	
	3. Single Cell Protein (SCP)	
	II BLENDING	
	4. Fuels	
10. Single Cell Protein (SCP)		

APPENDIX 6

TECHNICAL INFORMATION ON SELECTED CHEMICALS

APPENDIX 6

TECHNICAL INFORMATION ON SELECTED CHEMICALS

1. Glucose

Glucose is a simple, six-carbon sugar that can be derived from both hemicellulose and cellulose by hydrolysis. Major uses for glucose are food and food production, medicinal applications and as a primary fermentation product in the manufacture of alcohols. The majority of market glucose is produced from normal sugar processes, including the refinement of sugar cane and sugar beets, followed by hydrolysis of sucrose. The recent price history for glucose in domestic and international markets is as follows:

3-YEAR PRICE HISTORY - GLUCOSE

Year	Price C$/tonne
1979	310
1980	369
1981	465

Source: Statistics Canada

2. Xylose

Xylose is a simple,five-carbon sugar that can be derived from hemicellulose by simple hydrolysis. As with glucose, xylose is primarily derived from the hydrolysis of sucrose extracted from cane sugar or sugar beets. Its commercial applications include utilization as a monomer for some complex plastic compounds, for the preparation of tetrahydrofuran and furan on a supply/demand basis and as a reactant for production of xylitol. The 10 year international price history for xylose is as follows:

10 YEAR PRICE HISTORY - XYLOSE

Year	Price US$/kg	Year	Price US$/kg
1973	-	1978	1.40
1974	1.42	1979	2.56
1975	1.31	1980	2.96
1976	1.36	1981	3.33
1977	1.40	1982	3.22

Source: Chemical Market Reporter - December, 1982.

3. Acetone

Acetone is the simplest ketone, comprising a three-carbon chain. Acetone is derived from hemicelluloses by first stage hydrolysis followed by fermentation and also by hydrolysis and fermentation of glucose produced from cellulose. The major source of acetone is from oxidation of propylene from petrochemical sourcing. Acetone is a major reactant and solvent in the petrochemical and plastics industry, being used extensively as a solvent or solvent blend in many aspects of the paint, coatings, adhesive and polymer industry. The recent price history of acetone is shown as follows:

10 YEAR PRICE HISTORY - ACETONE

Year	East US$/kg	California US$/kg	West Rockies US$/kg
1973	.13	.14	.15
1974	.31	.33	.36
1975	.32	.33	.36
1976	.33	.36	.38
1977	.36	.38	.40
1978	.38	.40	.42
1979	.49	.51	.53
1980	.64	.67	.69
1981	.69	.71	.73
1982	.64	.67	.69

Source: Chemical Market Reporter - December, 1982.

4. Butanol

N-Butyl-alcohol is a four-carbon alcohol produced by hydrolysis and the fermentation of both hemicellulose and cellulose. Its primary use is as an intermediary for the production of butadiene for synthetic rubber and the production of graft copolymers. Substantial quantities of butyl alcohol are also used as a solvent within the coating and adhesives industry as a means of controlling evaporation rate of solvent blends. The recent pricing history of butanol is as follows:

10 YEAR PRICE HISTORY - BUTANOL

Year	Price C$/Tonne	Year	Price C$/Tonne
1972	158		
1973	172	1978	510
1974	399	1979	549
1975	478	1980	608
1976	432	1981	699
1977	496		

Source: Statistics Canada

5. **Xylitol**

Xylitol is a sweetener produced by the hydrogenation of xylose (see 2 above). In purified form, xylitol can be used as a substitute for sucrose by diabetics as its calorific value and sweetness is approximately equivalent to that of sucrose. It has also achieved some use as a sweetener in sugar-free chewing gums (U.S.A. only). However, its use has been restricted since publication of findings indicating side effects ranging from transient osmotic diarreah to increase in serum uric acid (Medical Letter, September 23, 1974).

6. **Furfural**

Furfural is a five-carbon cyclic aldoketose that can be produced from hemicellulose through the dehydration of xylose. Furfural is currently produced in major quantities from the extraction of oat hulls or corn cobs followed by hydrogenation and hydration. Furfural is used extensively by the synthetic polymer industry in production of a wide range of end-use chemicals including nylon, polyurethane foams, resins and plastics and some drug products. Recent price history of furfural is shown below.

10 YEAR PRICE HISTORY - FURFURAL

Furfural		Furfural Alcohol	
Year	Price US$/kg	Year	Price US$/kg
1973	.42	1973	.47
1974	.71	1974	.80
1975	.82	1975	.91
1976	1.04	1976	1.13
1977	1.14	1977	1.20
1978	1.14	1978	1.20
1979	1.14	1979	1.20
1980	1.22	1980	1.24
1981	1.47	1981	1.51
1982	1.47	1982	1.51

Source: Chemical Market Reporter

7. Salicin

Salicin, a carbohydrate having the formula $C_{13}H_{18}O_7$, is a complex chemical compound naturally occurring in poplars and willows and may be extracted in trace quantities from hydrolized cellulose or hemicellulose. Salicin is not currently available in major commercial quantities nor does it have major established markets. However, recent work undertaken by a number of pharmeceutical companies have indicated that strong analgesic properties, similar in nature to those of acetylsalicylic acid (aspirin) have been demonstrated for this compound. As no current major commercial application has been established, prices are most difficult to obtain. However, in the opinion of pharmeceutical manufacturers, the product would have a commercial value approximating that of salicylic acid whose recent price history is shown as follows:

10 YEAR PRICE HISTORY - SALICYLIC ACID

Year	Price US$/kg	Year	Price US$/kg
1973	1.07	1978	1.69
1974	1.69	1979	1.69
1975	1.69	1980	2.29
1976	1.69	1981	2.51

7. Glycerol

Glycerol is a three-carbon trihydroxy alcohol that can be produced from cellulose by hydrolysis to glucose followed by fermentation and extraction. Glycerol is commonly produced as a by-product of the petrochemical industry through hydroxylation of propane and/or propylene. Glycerol is used extensively within the chemical industry in the manufacture of soaps and plasticizers for the plastics, adhesives and coatings industries. The recent price history of glycerol is as follows:.

10 YEAR PRICE HISTORY - GLYCEROL

Year	Price US$/kg	Year	Price US$/kg
1973	.50	1978	1.11
1974	1.11	1979	1.14
1975	1.06	1980	1.41
1976	1.11	1981	1.79
1977	1.16	1982	1.61

9. Xantham Gums

Xantham gum is a complex carbohydrate produced by the fermentation of glucose derived from cellulose by hydrolysis. Xantham gums are commonly recovered from the forest industry residues resulting from manufacture of tall oils and turpines in the pine growing regions of the world. Xantham gums are used primarily in the manufacture of naval stores coatings and paint products. The recent price history of xantham gums are shown as follows:

10 YEAR PRICE HISTORY - XANTHAM GUMS

Food Grade		Industrial Grade	
Year	Price US$/kg	Year	Price US$/kg
1973	-	1973	-
1974	-	1974	-
1975	-	1975	-
1976	-	1976	-
1977	8.80	1977	6.42
1978	8.80	1978	6.42
1979	8.80	1979	5.42
1980	10.20	1980	8.00
1981	12.40	1981	8.76
1982	12.40	1982	9.29

Source: Chemical Market Reporter

10. Lactic Acid

Lactic acid can be produced from cellulose through the steps of hydrolysis and fermentation. Lactic acid is produced commercially as a by-product from milk processing as well as petrochemical sources. Major end uses are as components of adhesive manufacturing and food preservatives additives. The recent price history of lactic acid is as follows:

10 YEAR PRICE HISTORY - LACTIC ACID

Food Grade		Industrial Grade	
Year	Price US$/kg	Year	Price US$/kg
1973	.88	1973	.82
1974	.99	1974	2.22
1975	1.36	1975	1.30
1976	1.36	1976	1.30
1977	1.39	1977	1.41
1978	1.47	1978	1.41
1979	1.59	1979	1.53
1980	1.76	1980	1.71
1981	1.90	1981	1.84
1982	2.09	1982	2.04

Source: Chemical Market Reporter - December.

11. Ethanol

Ethanol can be produced readily from cellulose by hydrolysis and fermentation. Major industrial production of ethanol is from fermentation of grain product, agricultural waste, and by hydroxylation of ethane in petrochemical refining. Ethanol is one of the prime organic chemicals utilized by a wide variety of consumer industries including use as a solvent, as an intermediary, for manufacture of ethylene, polyethelene, plastics, ether, acetaldehyde, and chloroform. More recently it is being used as a motor fuel, either in pure form or as an additive to normal automotive gasoline. The recent price history of ethanol is listed below:

10 YEAR PRICE HISTORY - ETHANOL

Year	Price US$/Litre	Year	Price US$/Litre
1973	.15	1978	.30
1974	.23	1979	.38
1975	.27	1980	.49
1976	.31	1981	.52
1977	.32	1982	.47

Source: Chemical Market Reporter - December.

12. Butylene Glycol

Butylene glycol may be readily extracted from cellulose through hydrogenation and fermenation of glucose. Butylene glycol is a three carbon dihydroxy alcohol and is normally produced in substantial quantities as a by-product of the petrochemical refining industry. It is used primarily as an intermediary for the production of butadiene (used in synthetic rubbers and plastics). The recent price history of butylene glycol is as follows:

10 YEAR PRICE HISTORY - 1, 3 BUTYLENE GLYCOL

Year	Price US$/kg	Year	Price US$/kg
1973	.42	1978	.91
1974	.61	1979	.96
1975	.61	1980	1.33
1976	.61	1981	1.51
1977	.87	1982	1.51

Source: Chemical Market Reporter - December.

13. Hydroxymethyl Furfural

Hydroxymethyl furfural is a methylated furfural alcohol that can be produced from cellulose through fermentation and dehydration of glucose. Hydroxymethyl furfural is normally produced in commercial quantities from the by-products of agricultural refining industries or alternatively from the distilation of coal products. Hydroxymethyl furfural is used extensively as an intermediary in the synthetic polomer industry for the production of nylon, polyesters, resins, levelinic acid, plastics and drugs.

14. Butadiene

Butadiene may be produced from cellulose through hydrolysis and fermentation to butylene glycol followed by tertiary conversion to butadiene. Butadiene is a naturally occurring compound primarily obtained from rubber trees, alternatively produced in substantial commercial quantities through the major petrochemical industries. Its primary use is as a component in synthetic rubber and plastics. The recent price history of butadiene is as follows:

10 YEAR PRICE HISTORY - BUTADIENE

Year	Price US$/kg	Year	Price US$/kg
1973	.24	1978	.48
1974	.47	1979	.49
1975	.40	1980	.71
1976	.42	1981	.89
1977	.48	1982	.69

Source: Chemical Market Reporter - December.

15. Sorbitol

Sorbitol (glucitol) is a six-carbon polyol that can be produced from cellulose by hydrolysis to glucose, followed by hydrogenation. Sorbitol is commercially produced as a by-product of the sugar refining industry. Its uses include the production of propeneglycol sweeteners, humecants, glycerols and various synthetic vitamin compounds. The recent price history of sorbitol is shown as follows:

10 YEAR PRICE HISTORY - SORBITOL

Aqueous 70%		Pellets	Powder
Year	Price US$/kg	Price US$/kg	Price US$/kg
1973	.49	.68	.73
1974	.93	1.20	1.36
1975	.83	1.24	1.31
1976	.82	1.24	1.31
1977	.77	1.22	1.29
1978	.79	1.22	1.29
1979	.87	1.29	1.39
1980	1.11	1.58	1.64
1981	1.11	1.58	1.64
1982	.91	1.58	1.64

Source: Chemical Market Reporter - December.

16. Low Molecular Weight Phenols and Methylated Phenols

Phenols are the aromatic (cyclical hydrocarbon) constituent of the lignin portion of wood. Low molecular weight phenols can be extracted from lignin through pulping processes. Methylated phenols may then be produced from the low molecular weight phenol by further chemical reaction with the crude materials. Currently, low molecular weight phenols and methylated phenols have commercial application as substitutes for phenolic and urea-formaldehyde resins as used by the panel products industry in North America. They are also used as a grinding aid in production of portland cement, emulsifying agents for asphalt, dispersants in dye stuffs, additives to phenol-formaldehyde resins for use in spun glass insulation, moderators for herbicides and as additives to drilling muds. The major competition for the foregoing products are commercially produced phenol formaldehyde resins from the aldol-condensation of phenol and formaldehyde produced from petrochemical sources. A recent price history of low molecular weight phenols is shown as follows:

10 YEAR PRICE HISTORY - PHENOLS, METHYLATED PHENOLS

	Synthetic Phenol	Methyl Phenylacetate
Year	Price US$/kg	Price US$/kg
1973	.22	2.29
1974	.67	2.29
1975	.67	2.29
1976	.59	8.00
1977	.59	8.00
1978	.38	8.00
1979	.77	8.00
1980	.79	8.00
1981	.89	8.00
1982	.76	8.00

Source: Chemical Market Reporter - December.

17. Vanillaldehyde

Vanillaldehyde is the aldehyde of phenol (a cyclic aromatic hydrocarbon) and can be produced from poplar wood residue by extraction from lignin by-products. The major source of vanillin, on an international basis, is the extraction of pure vanillaldehyde from the vanilla bean in tropical regions. Small quantities are additionally produced from fossil fuel chemical conversion and from pulping by-products. There are three major markets for vanillaldehyde:

(a) As a pure aldehyde used in further synthetic reaction.

(b) For production of cosmetics, pharmaceuticals and plastic compounds,

(c) In the form of a tincture (solution in ethyl alcohol) under the market name of vanillin for use as food flavouring. A recent price history of vanillaldehyde and vanillin is as follows:

10 YEAR PRICE HISTORY - VANILLIN

Year	Vanillin Price US$/kg	Vanillaldehyde Price US$/kg
1973	7.49	18.56
1974	9.44	21.67
1975	9.17	23.61
1976	10.97	23.61
1977	11.89	23.61
1978	12.89	23.61
1979	-	23.61
1980	10.56	29.89
1981	9.44	29.18
1982	12.22	29.18

Source: Chemical Market Reporter

18. Methanol

Methanol is the simplest one-carbon alcohol and can be produced from hydrolysis and hydrogenation or fermentation of both hemicellulose and cellulose. Major competitive sources of methanol are as by-products of grain fermentation, agromass fermentation and from the throttled oxidation of methane gas. Methanol is considered to be one of the primary organic chemical building blocks and is used in a wide variety of synthetic operations both as a solvent and as a reactant. For example, it is used in the production of formaldehyde for further utilization in the production of condensate resins. A recent price history of methanol is shown as follows:

10 YEAR PRICE HISTORY - METHANOL

Year	Price US$/Litre	Year	Price US$/Litre
1973	.06	1978	.13
1974	.12	1979	.14
1975	.13	1980	.21
1976	.13	1981	.21
1977	.12	1982	.25

Source: Chemical Market Reporter

19. Acetic Acid

Acetic acid is the second carboxylic acid in the aliphatic series consisting of a two-carbon carboxyl acid. It may be readily produced by the simple hydrolysis of hemicellulose. Current production of acetic acid is derived from wood-based hemicellulose and alternatively by carboxylation of petrochemical derivatives. Acetic acid is a major bulk chemical and is used as a component of vinegar (food stuff) and as a reactant or solvent for a wide variety of major petrochemical and chemical applications. A recent price history of acetic acid is shown as follows:

10 YEAR PRICE HISTORY - ACETIC ACID

Year	Price US$/kg	Year	Price US$/kg
1973	.20	1978	.40
1974	.34	1979	.46
1975	.33	1980	.54
1976	.38	1981	.59
1977	.40	1982	.51

Source: Chemical Market Reporter

APPENDIX 7

LISTING OF CURRENTLY INSTALLED PETROCHEMICAL INDUSTRIES

PETROCHEMICAL SURVEY

ALBERTA		FEEDSTOCK		PRODUCTS	
Company	Plant Location	Type	Capacity*	Type	Annual Capacity
Celanese Canada Inc.	Edmonton	Butane Methanol Acetaidehyde Ethylene	2,000 b/d	Formaldehyde, Acetic Acid & Anhydride Pentaerythritol Vinyl Acetate	200 Million Lbs. 160 Million Lbs. 55 Million Lbs. 100 Million Lbs.
Cominco Ltd.	Calgary	Natural Gas	14mmcf/d	Ammonia Ammonia Nitrate Urea	120,000 Tons 35,000 Tons 75,000 Tons
Cominco Ltd.	Carseland	Natural Gas	50 mmcf/d	Ammonia Urea	470,000 Tons 500,000 Tons
Diamond Shamrock Alberta Gas Ltd.	Fort Saskatchewan	Vinyl Chloride	-	Polyvinyl Chloride	100,000 Tonnes
Dow Chemical Canada Inc.	Fort Saskatchewan	Ethylene, Phenol, Ammonia, Chlorine	- -	Ethylene Oxice and Glycols, Ethanolamines, Vinyl Chloride, Ethylene Dichloride, Phenoxy Herbicides, Chlorine, Caustic And Sytrofoam.	
Esso Chemical Canada	Redwater	Natural Gas	-	Nitrogenous and Phosphalic Fertilizers	750,000 Tons
Inland Chemicals	Fort Saskatchewan	Sulphur	55,000 Tonnes/yr.	Sulphuric Acid	170,000 Tonnes
Sherritt Gordon Mines Ltd.	Fort Saskatchewan	Natural Gas Sulphur	9 bcf/yr. 61,500 Tons/yr.	Ammonia Urea Ammonia Sulphate Phosphate Fertilizers	150,000 Tons 110,000 Tons 145,000 Tons 135,000 Tons
Thio-Pet Chemicals Ltd.	Fort Saskatchewan	Natural Gas Sulphur Hydrogen	26 mmcf/yr.then 16 Million Ls.	Hydrogen Sulphide Carbon Disulphide	10 Million Lbs. 9.5 Million Ltd.
Western Co-operative Fertilizers Ltd.	Calgary	Natural Gas Sulphur	10.5 mmcf/d 350 Tons/d	Nitrogenous and Phosphatic Fertilizers Ammonia	350,000 Tons 64,000 tons
Western Co-operative Fertilizers Ltd.	Medicine Hat	Natural Gas Sulphur	10.9 mmcf/d 180 Tons/d	Nitrogenour and Phosphatic Fertilizers Ammonia	280,000 Tons 65,000 Tons
BRITISH COLUMBIA					
Borden Chemical (Western) Ltd.	Vancouver	Methanol	3.5 Million Gals.	Formaldehyde 37%	50 Million Lbs.
Cominco Ltd.	Trail	Natural Gas	6.5 mmcf/d	Ammonia	75,000 Tons
Dom Chemical Canada Inc.	Ladner	Toluene	-	Phenol, Benzoic Acid	
Esso Chemical Canada	Ioco	Naphtha	-	Toluene Aliphatic Solvents	15 Million Gals. 22 Million Lbs.
Inland Chemicals Ltd.	Prince George	Sulphur	13,000 Tonnes	Sulphuric Acid	35,000 Tonnes
Ocelot Industries	Kitimat	Natural Gas	13.2 BCF/Ann.	Methanol	400,000 Tonnes
Reichhold Ltd.	Port Moody	Methanol	920,000 m^3	Formaldehyde (37%)	16,500 Tonnes

PETROCHEMICAL SURVEY

		FEEDSTOCK		PRODUCTS	
Company	Plant Location	Type	Capacity*	Type	Annual Capacity
MANITOBA					
Simplot Chemical Co.	Brandon	Natural Gas	18 mmcf/d	NH_3	35,000 Tonnes
				AN (34-0-0)	40,000 Tonnes
				Urea (46-0-0)	90,000 Tonnes
				N_2 solution (28-0-0)	185,000 Tonnes
				Phos Solution (10-34-0)	25,000 Tonnes
				Ammonium Thiosulphate (12-0-026)	15,000 Tonnes
NOVA SCOTIA					
Esso Chemical	Halifax	Propylene, Butylene	-	Heptene	37 Million Lbs.
ONTARIO					
Allied Chemical Canada Ltd.	Amherstburg	Natural Gas	-	Soda Ash	400,000 Tons
		Bunker C		Calcium Chloride	350,000 Tons
				Fluorinated Hydrocarbons	20,000 Tons
				Hydrogen Fluoric Acid	45,000 Tons
Bakelite Thermosets Ltd.	Belleville	Methanol	-	Formaldehyde	16 Million Lbs.
		Phenol		Phenolic resins and Compounds	50 Million Lbs.
BASF Canada Inc.	Cornwall	Orthoxylene	-	Phthalic Anhydride	90 Million Lbs.
				Plasticizers	60 Million Lbs.
BP Canada Inc.	Oakville	Propylene/Propane	66,775 m^3/yr.	Propylene	42,927 m^3
		FCCU C_3/C_4	200,324 m^3/yr.	Proplylene Propane	73,134 m^3
Carbot Carbon Ltd.	Sarnia	Petroleum Fractions	-	Carbon Black	175 Million Lbs.
C-I-L Inc.	Courtright	Natural Gas	50 mmcf/d	Ammonia, Nitrogenous & Phosphatic Fertilizers	700,000 Tons
C-I-L Inc.	Cornwall	Natural Gas	1.5 mmcf/d	Carbon Bisulphide	31,000 Tons
				Carbon Tetrachloride	17,000 Tons
				Sodium Hydrosulphide	10,000 Tons
Celanese Canada Inc.	Cornwall	Natural Gas	-	Methanol	50 000 Tonnes
Chinook Chemicals Ltd.	Sombra	Methanol	-	Methylamines	-
		Ammonia	-	DMF	10,000 Tons
		Ethylene Oxide	-	Choline Chloride	6,000 Tons
Cities Service Chemicals Ltd.	Hamilton	Aromatic Concentrate	130,000 Tons	Carbon Black	70,000 Tons
Cornwall Chemicals Ltd.	Cornwall	Natural Gas	1.5 mmcf/d	Carbon Bisulphide	33 000 Tonnes
				Carbon Tetrachloride	20 000 Tonnes
				Sodium Hydrosulphide	15 000 Tonnes
Cyanamid Canada Inc.	Niagara Falls	Natural Gas	265 mmcf/d	Ammonia	245,000 Tons
				Urea	108,000 Tons
				Nitric Acid	165,000 Tons
				Ammonium Nitrate	200,000 Tons
				Liquid Carbon Dioxide	55,000 Tons

PETROCHEMICAL SURVEY

ONTARIO		FEEDSTOCK		PRODUCTS	
Company	Plant Location	Type	Capacity*	Type	Annual Capacity
Dow Chemical of Canada Ltd.	Sarnia	Benzene, Butadiene Ethylene, Natural Gas	-	Polyethylene (L&HD), Polystyrene Latex Styrene, Vinyl Chloride, Ethylene Dichloride, Chlorinated Solvents, Ethylene Oxide and Glycola, Propylene Oxide and Glycola, Chlorine, Caustic and Epoxy Resin.	
Dow Chemical of Canada Ltd.	Weston	Polystrene	-	Styrofoam	-
Du Pont Canada Inc.	Sarnia	Ethylene	-	Polyethene	500 Million Lbs.
Ethyl Canada Inc.	Sarnia	Ethylene	25 Million Lbs.	Ethyl Chloride,	70 Million Lbs.
		Chlorine	6,000 Tons	Anti-Knock Compounds	50 Million Lbs.
		Anhydrous	14,000 Tons	Ethylene Dichloride	20 Million Lbs.
				Gas & Oil Additives	2 Million Lbs.
				Aluminum Alkyls	1 Million Lbs.
				Pharmaceuticals	100 000 kg
Esso Chemicals Canada	Sarnia	Propylene	-	Nonene Tetramar	120 Million Lbs.
		Petroleum Fraction	-	etroleum Additives	-
		Naptha	-	Aliphatic Solvents	800,000 Bbls.
		Naptha Fractions	-	Benzene, Tolune, Xylene	30 Million Gals.
		Petroleum Fractions	-	Ethylene	500 Million Lbs.
				Propylene	165 Million Lbs.
				Crude Butadiene	40 Million Lbs.
				Aromatic Tar	175 Million Lbs.
		Vinyl Chloride Monomer		Polyvinyl Chloride	-
				Homo Polymer Resins	100 Million Lbs.
B.F. Goodrich Canada Inc.	Niagara Falls	Vinyl Chloride	-	Polyvinyl Chloride	220 MMillion Lbs.
B.F. Goodrich Canada Inc.	Kitchener	Polyvinyl Chloride Resins	-	PVC Compounds	35 Million Lbs. -
Monsanto Canada Ltd.	Sarnia	Styrene Acrylonitrie Butadiene	-	Nylon 66, Polyester Fibre	-
Nitrochem Inc.	Maitland	Natural Gas	8.5 mmcf/d		
		Ammonia	200 st/d	ABS and SAN Resins	-
				Ammonia	90,000 Tons
				Nitric Acid	300,000 Tons
				Ammonium Nitrate	200,000 Tons
				Urea	55,000 Tons
				Nitrogen Solutions	50,000 Tons
Petrosar Ltd.	Sarnia	Naptha	-	Ethylene	1 Billion Lbs.
				Propylene	700 Million Lbs.
				Butadiene, Butylene, Isobutylene	500 Million Lbs.
				Benzene	350 Million Lbs.
				Toluene, Xylene	280 Million Lbs.

PETROCHEMICAL SURVEY

ONTARIO

		FEEDSTOCK		PRODUCTS	
Company	Plant Location	Type	Capacity*	Type	Annual Capacity
Polysar Ltd.	Sarnia	Steam Cracker C-4 Cuts Isobutylene Light Oil Benzene Ethylene Butadiene Styrene Acrylonitrie	350 000 t 60 000 t 80 000 t 250 000 t 120 000 t 150 000 t 40 000 t 8 000 t	Butadiene Isobutylene Butyl Rubber Benzene Styrene Synthetic Rubber and Latices	160 000 t 60 000 t 50 000 t 65 000 t 380 000 t 210 000 t
Polysar Ltd.	Cambridge	Styrene	27 000 t	Polystyrene	30 000 t
Reichhold Ltd.	Thunder Bay	Methanol	2 900 000 cum	Formaldehyde 37%	52 000 Tonnes
Reichhold Ltd.	North Bay	Methanol	5 100 000 cum	Formaldehyde 37%	92 000 Tonnes
Shell Canada	Sarnia	Propylene, Reformate	-	Polypropylene Isopropyl Alcohol Benzene, Toluene & Xylenes	70 000 Tonnes 92 000 Tonnes 168 000 cum
Suncor Inc.	Sarnia	-	-	Benzene Toluene Solvent Xylene Ortho Xylene	71 600 cum 186 260 cum 145 800 cum 32 250 cum
Surpass Chemicals	Scarborough	-	-	Benzene Additives	71 600 cum 4 Million Gal.
Texaco Canada Inc.	Port Credit	Refinery Fractions	-	Benzene, Toluene, Hexana, Xylene	285,000 Bbls.
Union Carbide Canada	Moore Twp.	Ethylene	-	Polyethylene	400 Million Lbs.
QUEBEC					
Allied Chemicals Canada Ltd.	Valleyfield	-	-	Sulphuric Acid	120,000 Tons
BASF Canada Inc.	Laval	Natural Gas Styrene Propylene Naptha Isobutyraldehyde	- - - - -	Expandable Polystrene Oxo Alcohol	30 Million Lbs. 200 Million Lbs.
Commercial Alcohols	Varennes	Ethylene	-	Ethyl Alcohol	70 000 Tonnes
Dow Chemical Canada Inc.	Varennes	Polystyrene	-	Styrofoam	-
B.F. Goodrich Canada Inc.	Shawinigan	Vinyl Chloride PVC Resins	-	Polyvinyl Chloride PVC Compounds	100 Million Lbs. 45 Million Lbs.
BP Canada Inc.	Montreal	FCCUC_3/C_4	186 337 cum/yr.	Propylene/Propane	66 775 cum
Esso Chemical	Montreal	Propylene Butylene	- -	Heptene Octene	17 000 Tonnes 14 000 Tonnes

PETROCHEMICAL SURVEY

QUEBEC

Company	Plant Location	FEEDSTOCK		PRODUCTS	
		Type	Capacity*	Type	Annual Capacity
Gulf Canada Ltd.	Montreal	Aromatics	520 ML	Cyclohexane	120 ML
				Cumene	58 ML
		Cumene Hydrogen	-	Phenol, Acetone, Bisphenol A, Acetone Derivatives	9 000 Tonnes
Hercules Canada Ltd.	Varennes	Propylene	-	Polypropylene	110 Million Lbs.
Monsanto Canada Ltd.	La Salle	Styrene, Alcohols, Benzene, Phthalic Anhydride	-	Polystyrene, Plasticizers, Malaic Anyhdride, ABS & SAN Resins Corting Resins	
Petro-Canada	Montreal	Reformate	-	Benzene	35 Million Gals. U.S.
		Reformate	-	Toluene	8.5 Million Gals. U.S.
		Reformate	-	Xylenes	40 Million Glas. U.S.
		Butenes	-	Polyisobutene	6,000 Tons; 15 Million Lbs.
		Poly Gasoline	-	Nonenes	2 Million Gals. U.S.
Petromont	Montreal East	Refinery gas	N/A	Ethylene	120 Million Lbs.
		Concentrates		Propylene	150 Million Lbs.
		P/P stream	200 Million Lbs.	Acetylene	
				Butanes mixture	
				Aromatics	
Petromont	Varennes	Naptha Distillate	6.5 Million Bbls.	Ethylene	430 Million Lbs.
				Propylene	200 Million Lbs.
				Butadiene	145 Million Lbs.
				Aromatic gasolines	500 Million Lrs.
				Acetylene	
				Other derivatives	
Polysar Ltd.	Pointe aux Trembles	Styrene	33 000 t	Polystyrene	38 000 Tonnes
Reichhold Ltd.	Ste. Therese	Methanol	77 000 cum	Formaldehyde 37%	14 000 Tonnes
Shell Canada	Montreal	Propylene	-	Isopropyl Alcohol	27 000 Tonnes
				Acetone, DMK	12 000 Tonnes
				Resins	4 300 Tonnes
Sulconan Inc.	Montreal	Refinery Gas	7 mmcf/d	Sulphur	125,000 Long Tons
Union Carbide Canada	Montreal	Ethylene		Polyethylene	300 Million Lbs.
				Ethylene Oxide	150 Million Lbs.
				Ethylene Glycol	180 Million Lbs.

APPENDIX 8

CANADA - IMPORTS AND EXPORTS OF CHEMICALS

APPENDIX 8

CANADA - IMPORTS AND EXPORTS OF CHEMICALS

IMPORTS - PHENOLS

	1977		1978		1979		1980		1981	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Phenol Sulphonic Acid	-	-	-	-	-	-	-	-	160	694
Zinc Phenolic Sulfonate	11	2,364	13	3,538	-	-	14	3,357	6	2,667
Sulphonated Phenols	137	869	45	2,000	73	1,644	40	1,100	22	818
Halogenated Phenols	-	-	67	507	14	1,429	12	1,500	12	1,333
Nitrated Deriv. Phenol	169	3,325	408	2,404	240	3,237	295	5,390	248	5,008
Phenol Alcohol Derivs	923	727	499	619	161	1,031	37	4,351	15	3,067
Phenol Formaldehyde Resins	7,250	708	12,051	564	11,812	760	7,681	909	5,746	1,374
Xylenol and Isomers	17	1,882	-	-	120	983	8	1,375	62	1,210
Thymol	2	11,500	8	1,500	7	857	13	846	21	810
Paraphenol-phenol	-	-	-	-	-	-	11	3,364	18	4,278
Beta-napthol	143	1,552	179	1,637	375	1,667	217	1,415	210	1,657
Octyl-phenol	124	823	-	-	190	1,353	158	1,709	174	1,743
Nonyl-phenol	815	617	701	599	580	714	320	1,087	871	1,183
Monophenol, NES	59	1,661	542	1,098	833	1,934	700	1,733	580	2,991

IMPORTS - CRESOLS

	1977		1978		1979		1980		1981	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Orthocresol	-	-	389	941	162	1,080	337	1,365	349	1,814
Metacresol	-	-	-	-	-	-	11	6,545	6	2,000
Paracresol	331	1,550	219	1,689	383	2,379	309	3,602	212	3,425
Butylated Hydroxytoluene	169	1,686	156	1,769	205	2,863	235	4,383	251	3,797
Cresol mixed isomers	-	-	126	1,151	156	1,442	227	1,559	239	2,159
Cresol derivatives, NES	54	1,500	10	2,900	31	1,129	102	1,353	44	1,500

Source: Statistics Canada

IMPORTS - XANTHATES

	1977		1978		1979		1980		1981	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Potassium Amylxanthate	-	-	121	1,314	537	1,056	1,054	1,318	1,285	1,430
Sodium Butylxanthate	-	-	-	-	-	-	47	1,638	9	1,333
Benzylxanthate	-	-	-	-	-	-	-	-	-	-
Sodium Isopropylxanthate	-	-	-	-	-	-	951	1,026	999	1,105
Potassium Isopropylxanthate	-	-	-	-	-	-	-	-	9	1,000
Sodium Ethylxanthate	-	-	-	-	-	-	25	1,080	127	1,283
Potassium Methylxanthate	-	-	-	-	-	-	-	-	-	-
Xanthates, NES	351	1,111	-	-	103	1,291	44	1,318	26	1,192

IMPORTS - SYNTHETIC RESINS FROM NATURAL SOURCES

	1977		1978		1979		1980		1981	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Tall Oil Syn. Resins	-	-	-	-	66	1,500	1	2,000	96	2,250
Resins from Natural Resin	1,801	1,062	2,860	1,102	3,980	1,309	5,831	1,342	6,510	1,670
Ester Gums	379	1,166	496	1,141	685	1,530	927	1,757	1,033	1,790
Run Gums	-	-	-	-	-	-	7	1,571	6	1,667
Syn. Res., NES	780	990	1,252	1,405	1,832	1,677	1,807	2,065	1,803	1,812

IMPORTS - SURFACANTS

	1977		1978		1979		1980		1981	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Amide base Industrial	-	-	823	1,317	642	1,816	1,095	1,648	3,175	771
Amphdytic base Industrial	-	-	144	1,354	212	1,288	92	1,652	500	1,672
Ampholytic base Industrial	-	-	622	1,693	631	1,369	2,802	1,280	4,498	1,461
Cationic base Industrial	-	-	103	1,447	328	1,902	198	2,283	849	1,981
Compounded NES Industrial	16,638	1,140	18,295	1,295	14,955	1,527	14,218	1,754	8,523	2,011
Ethoxylated Industrial	6,142	955	7,987	965	6,759	1,104	3,784	1,472	3,095	1,791
Fatty Acid Ester Industrial	-	-	607	1,494	329	1,723	358	1,911	509	2,193
Non Ionic Industrial	-	-	549	1,486	1,191	1,931	980	2,185	1,895	2,846
Olefin Sulfinate Industrial	-	-	95	1,137	37	1,405	8	875	31	742
Phenol base Industrial	-	-	74	1,581	209	1,191	266	1,135	227	1,599
Sorbitan Deriv. Industrial	-	-	661	1,711	258	1,620	230	1,809	314	1,882
Sulphate base Industrial	799	1,044	746	1,116	722	1,357	625	1,754	719	2,039
Sulphonate base Industrial	1,902	753	2,029	906	3,030	1,023	2,802	1,280	4,498	1,461

Source: Statistics Canada

IMPORTS - GLUCOSE AND SYRUP

	1977		1978		1979		1980		1981	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Glucose high fructose	-	-	106	406	224	393	11	636	7,672	440
Glucose high fruct, NES	-	-	4,867	310	3,490	466	11,243	576	2,647	450
Solution Pharm. Grade	-	-	-	-	-	-	-	-	-	-
Syrup Food Grade	-	-	3,352	220	7,494	235	30,112	291	17,884	433
Syrup, NES	1,455	523	1,116	687	950	1,051	1,944	845	1,817	849

IMPORTS - YEAST

	1977		1978		1979		1980		1981	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Yeast Active (Nonmed)	1,705	120	795	1,141	904	975	787	1,708	806	1,981
Yeast Dead or Inactive	-	-	1,241	1,150	1,342	1,444	1,068	1,624	1,170	1,691

IMPORTS - LIGNIN

	1977		1978		1979		1980		1981	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Sulphite Liquor	33,183	31	34,059	34	26,332	39	36,209	39	21,200	54
Lignosulphonates	431	142	521	240	647	198	1,338	258	496	232
Pitch Lignin	9,383	93	7,986	113	4,685	178	3,679	203	4,786	217

Source: Statistics Canada

IMPORTS - MISCELLANEOUS PRODUCTS AND CHEMICALS

	1977		1978		1979		1980		1981	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Isopthalic Acid	1,565	654	1,810	697	2,142	845	1,705	1,045	2,040	1,155
Latex Crude	5,201	778	3,648	987	5,003	1,025	3,422	1,494	3,336	1,520
Rayon	1,987	6,526	1,977	7,898	1,602	9,734	1,048	10,795	917	15,573
Urea	58,516	131	91,448	154	93,856	163	73,562	220	92,670	265
Drilling Mud	42,467	205	3,888	743	44,214	283	32,176	232	29,439	277
Tall Oil Fatty Acids	5,159	575	4,577	638	4,753	696	4,037	671	4,386	553
Hydrolyzed Veg Protein	854	1,595	883	1,484	962	1,541	1,103	1,667	991	2,005
Acetic Acid	-	-	691	357	257	658	403	871	511	691
Alkyd Polyester Resins	1,767	877	22,824	954	18,292	1,240	3,471	2,135	2,834	2,577
Vanillin	145	1,538	11	17,545	7	14,286	11	18,273	11	11,091
Benzoic Acid	127	906	61	2,607	41	1,293	-	-	-	-
Furfural	-	-	572	1,273	347	1,216	304	1,312	740	1,265
Xylose	5,342	256	6,451	293	16,790	999	4,094	566	9,922	516
Gluten & G meal(animal)	1,419	215	1,573	220	1,942	273	6,806	286	5,343	330

IMPORTS - LIQUIFIED GAS

	1977		1978		1979		1980		1981	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Methane	161	52	138	50	127	76	506	28	916	27
Ethane	212	14	17	3	17	52	53	45	59	109
Propane	3,694	52	3,707	80	4,149	65	1,953	93	4,458	47
Butane & Isobutane	3,369	14	3,616	17	6,390	21	2,919	40	4,042	31
Liquid Pet. Gas NES	1,631	20	4,119	20	5,672	19	261,922	9	1,338,433	11

Source: Statistics Canada

IMPORTS - ALCOHOLS

	1977		1978		1979		1980		1981	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Methanol	10,288	91	11,737	125	709	141	558	292	859	242
Ethanol	20	1,350	23	1,043	135	963	228	990	476	851
Butyl Alcohol Normal	264	496	292	510	266	549	209	608	355	699
Ethyl Isohexanol	-	-	85	588	22	955	-	-	40	750
Octanol	-	-	152	658	156	724	117	838	70	1,071
Isooctyl Alcohol	64	594	23	739	-	-	25	600	7	429
Decyl Alcohol	1,293	636	1,534	812	2,609	811	2,257	1,110	2,546	1,358
Octyl-Decylalcohol	205	668	237	785	-	-	59	1,356	64	1,656
Isodecanol	-	-	-	-	-	-	1,628	883	2,676	1,042
Myristyl alcohol	-	-	42	333	33	545	62	806	11	1,000
Tridecanol	-	-	439	859	925	806	870	1,152	804	1,453
Oleyl alcohol	-	-	53	1,943	23	2,609	32	2,437	56	2,536
Cetyl alcohol	-	-	232	1,134	232	1,491	131	2,313	116	2,216
Stearyl alcohol	20	850	72	875	167	928	50	1,560	108	2,093
Lauryl alcohol	108	759	37	1,054	189	1,270	287	603	281	1,680
2,6 Dimethy-4-Heptanol	-	-	-	-	-	-	4	1,250	4	1,500
Linalol	-	-	41	1,024	36	1,361	21	1,286	19	1,263
Citronellol	-	-	50	1,480	21	1,476	37	1,973	40	1,250
Ethyl Hexanediol	-	-	-	-	-	-	44	3,205	9	1,556
Fatty Alcohol NES	6,610	565	4,838	842	4,594	929	6,414	1,239	5,234	1,336
Propyl alcohol & Isomers	2,275	563	2,607	577	2,236	843	1,783	966	2,534	783
Butyl alcohol & Isomers	7,485	439	7,460	484	764	764	764	938	293	2,310
Butyl alcohol & Isomer Mix.	-	-	-	-	31	581	11	1,455	1	1,000
Amyl alcohol & Isomers	1,203	550	1,051	692	526	715	524	975	384	1,047
Hexanol	-	-	101	891	49	1,020	73	1,384	20	1,350
Sat. Acyclic monohydric Alc.	10	1,600	95	725	31	1,161	58	2,431	100	3,800
Allyl Alcohol	-	-	14	1,357	31	1,581	41	2,195	1	1,000
Etchloruinol in bulk	-	-	-	-	-	-	2	43,000	1	79,000
Unsat.acyclic monohydric alc.	39	3,538	12	3,083	62	1,629	46	696	12	
Polyhydric Acyclic Alot.Der.	209	4,316	487	1,809	599	2,482	948	2,887	624	3,840
Cycl. Alcohol & Deriv.	-	-	-	-	30	1,600	10	3,200	23	5,333
Benzyl Alcohol	214	1,486	216	1,523	297	1,798	73	3,302	129	2,101
Phenethyl alcohol	-	-	10	2,220	13	2,077	50	2,260	33	1,818
Cynnamyl alcohol	-	-	6	2,167	4	1,500	12	1,500	11	1,273
Aromatic alcohol & Der.	12	3,333	731	802	459	1,094	436	1,126	183	1,249
Salicyl alcohol	-	-	-	-	-	-	-	-	2	1,000

Source: Statistics Canada

IMPORTS - ALDEHYDES AND KETONES

	1977		1978		1979		1980		1981	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Paraldehyde	1	3,000	-	-	1	5,000	1	1,000	1	2,000
Cyclic Polymers of Alc.	-	-	-	-	-	-	12	1,833	2	3,000
Butyraldehyde	408	480	293	577	241	552	197	1,870	1	2,000
Glyoxal	833	743	974	724	1,073	853	1,091	1,061	909	9,988
Sqt. Acycloc Ald NES	97	567	110	545	177	831	524	748	702	1,021
Formaldehyde	9,094	169	9,980	203	7,313	240	3,778	370	1,951	336
Acetaldehyde	7,695	388	8,433	402	10,039	486	7,766	635	7,071	812
Aldehyde Function Comps.	9,582	477	1,718	1,156	1,862	1,146	2,311	1,412	2,400	1,537
Crutonaldehyde	-	-	-	-	-	-	12	917	84	774
Unsat. Acyclic Aldehydes	-	-	-	-	-	-	-	15,000	4	3,750
Lycl Aldehydes	-	-	-	-	-	-	1	9,000	4	1,750
Benzylaldehyde	-	-	10	1,700	23	2,696	13	1,231	111	1,000
Cinnemaldehyde	-	-	22	2,136	9	4,444	24	4,583	37	1,622
Phenacelaldehyde	-	-	-	-	-	-	19	2,053	4	1,500
Aromatic Aldehydes	61	1,656	60	5,700	43	6,186	76	7,605	49	7,041
Acetaldol	-	-	-	-	-	-	15	933	-	-
Aldehyde-Alcohol Comps.	98	1,316	142	1,042	170	976	153	948	79	1,228
Heliotropin	-	-	8	5,375	10	2,600	30	1,267	46	1,283
Ethyl Vanillin	-	-	17	14,706	10	17,000	13	22,077	11	19,818
Complex oxygen function alds	-	-	7	3,143	57	1,211	109	1,798	319	2,492
Ald.-Functioning compound	235	1,579	69	2,290	31	2,548	20	2,950	37	3,297
Acetylacetone	1,877	349	75	3,307	-	-	57	2,684	44	2,932
Methyl Normal Propylketone	-	-	-	-	-	-	86	1,233	127	1,496
Methyl Isopropylketone	-	-	-	-	-	-	-	-	61	787
Dimethyl Ketone	-	-	1,990	902	348	520	940	563	1,467	311
Diethyl Ketone	-	-	-	-	-	-	-	-	16	62
Methylethyl Ketone	2,824	428	2,637	472	6,651	571	7,637	820	11,172	931
Methyl isobutyl ketone	398	616	280	707	389	679	467	520	248	1,290
Diisobutyl Ketone	143	601	192	729	113	850	58	862	93	828
Diacetyl	-	-	-	2,000	-	-	5	1,800	5	2,000
Acyclic Ketones	240	946	261	1,471	319	2,942	249	2,775	410	2,263
Cyclic Ketones	-	-	5	12,000	8	12,375	6	13,333	1	23,000
Aromatic Ketones	46	978	5	7,400	-	-	6	2,167	7	1,714
Diacetone Alcohol	734	623	864	623	840	830	870	1,009	986	1,010
Oxygen Function Kets.	30	1,633	582	1,064	936	1,081	35	4,057	16	7,312

Source: Statistics Canada

EXPORTS - CHEMICALS

	1972		1973		1974		1975		1976	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Alcohols	36,889	224	49,000	235	48,531	561	89,301	331	180,025	223
Phenols	5,217	377	4,902	386	4,996	670	3,098	888	2,905	949
Aldehyde function group	1,438	4,138	1,739	4,020	2,590	4,033	1,971	5,349	1,919	7,240
Ketone & Quinone comps	1,440	72	3,485	191	2,040	558	60	1,017	127	488
Chem. modified oils fats	246	3,780	206	3,985	210	4,738	331	1,746	301	2,203

	1977		1978		1979		1980		1981	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Alcohols	330,398	206	352,979	236	300,963	328	335,392	433	514,454	431
Phenols	1,899	967	2,482	973	4,150	1,224	3,497	1,548	2,593	1,622
Aldehyde function group	2,822	8,640	2,412	10,125	2,741	10,263	7,200	4,055	11,597	2,577
Ketone Quinone Comps	93	796	29	1,345	2,918	557	2,877	763	7,002	648
Chem. modified oils fats wax	385	735	419	2,981	295	4,258	281	3,601	309	469

Source: Statistics Canada

APPENDIX 9

CANADIAN FEED EXPORTS

APPENDIX 9

CANADIAN FEED EXPORTS

Feed	1972		1973		1974		1975		1976	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Hay & Clover	108,352	26	136,047	30	98,578	32	61,161	60	108,816	54
Forage, NES	647	12	415	29	195	26	434	25	231	22
Straw	12,840	23	15,090	24	11,427	25	5,738	39	7,532	30
Chopped Feed Oats	376	35	354	39	157	115	312	77	841	98
Chopped Feed, NES	191	63	255	43	80	75	204	29	112	63
Hulls, Screenings	102,934	29	93,552	36	52,204	51	52,296	72	77,013	75
Oat By-Products, NES	9,330	10	9,424	135	4,761	215	3,162	164	4,169	158
Wheat Bran Shorts	229,755	51	211,349	80	132,378	98	144,309	97	225,103	94
Grain Feeds, NES	19,833	43	140,500	65	2,934	99	45,085	28	32,410	63
Alfalfa (dehyd.)	-		-	-	-	-	79,768	89	148,596	113
Gluten Feed	21,747	169	12,019	129	12,633	239	12,637	365	15,803	348
Rapeseed Screenings	-		-		-	-	18,444	50	21,468	79
Total	506,005	46	619,005	46	315,347	74	423,550	85	642,094	93

	1977		1978		1979		1980		1981	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Hay & Clover	123,330	54	123,738	58	67,807	60	55,707	63	70,265	72
Forage, NES	384	21	2,138	17	754	48	347	17	322	68
Straw	13,020	34	16,830	44	13,506	51	7,769	49	8,021	64
Chopped Feed Oats	664	86	2,876	78	2,698	107	2,418	136	1,701	172
Chopped Feed, NES	604	114	37	81	206	146	487	127	679	94
Hulls Screenings	46,162	77	53,878	63	29,150	116	29,638	92	23,867	101
Oat By-Products, NES	4,684	155	3,818	265	8,700	223	2,985	268	1,016	343
Wheat Bran Shorts	248,077	94	273,936	94	300,204	112	194,246	148	190,563	137
Grain Feeds, NES	17,369	73	15,185	82	8,577	107	10,896	105	21,394	77
Alfalfa (dehyd.)	194,704	114	188,593	115	244,300	113	196,188	141	143,871	160
Gluten Feed	16,018	293	28,510	196	28,129	211	62,336	176	46,154	178
Rapeseed Screenings	19,518	107	25,396	75	35,545	110	56,780	128	46,993	121
Total	684,534	95	734,935	94	739,576	111	619,797	147	554,846	132

Source: Statistics Canada
"NES" - not elsewhere specified.

APPENDIX 10

CANADA, FEED IMPORTS

APPENDIX 10

CANADA, FEED IMPORTS

Feed/Year	1972		1973		1974		1975		1976	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Hay Forage Straw	81,240	41	93,123	58	115,148	75	155,271	73	129,158	79
Dairy & Cattle Feeds	13,075	76	12,586	109	7,815	157	10,337	207	7,172	206
Feed (conc) & Complete Feeds	12,558	165	17,390	255	20,185	274	32,362	289	21,451	294
Total	106,873	60	123,099	91	143,148	108	187,970	106	157,781	113

	1977		1978		1979		1980		1981	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Hay, Forage Straw	87,968	56	97,576	73	125,830	85	132,931	94	111,344	91
Dairy & Cattle Feeds	7,561	214	3,564	324	2,794	334	3,017	375	2,418	357
Feed (conc) & Complete Feeds	26,319	312	23,020	417	26,743	468	26,410	492	24,553	563
Total	121,848	122	124,160	144	155,367	155	162,358	164	138,315	180

Source: Statistics Canada

APPENDIX 11

CANADIAN CONSUMPTION OF GRAIN BY FEED INDUSTRY

1971 to 1980

APPENDIX 11

CANADIAN CONSUMPTION OF GRAIN BY FEED INDUSTRY 1971 to 1980

Grain Products	1971		1972		1973		1974		1975	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Wheat	884,055	58	912,406	61	985,908	99	802,309	135	709,219	140
Barley	879,806	51	937,788	51	999,139	82	1,177,425	116	986,991	121
Corn	865,932	58	882,250	60	895,630	93	1,169,294	130	1,087,987	130
Flaxseed	462	102	2,155	109	1,484	90	1,032	121	14,423	126
Oats	446,401	51	441,045	53	436,134	82	468,612	113	348,131	121
Peas	5,811	104	4,829	111	6,116	116	4,949	197	8,334	183
Rice	-	-	-	-	2,740	54	1,090	109)		
Rye	1,731	44	2,651	46	1,549	67	4,578	99)	15,438	221
Buckwheat	328	64	988	67	1,051	69	10	200)		
Whole Grains	34,418	48	28,628	51	28,917	77	40,971	107	33,960	104
Screenings	261,431	30	295,314	31	247,063	53	222,863	79	176,057	89
Seed (Clover, Millet, Sunflower)	4,702	118	253	134	212	142	357	154	5	200
Sub-Total	3,385,077	53	3,508,307	55	3,605,943	88	3,893,490	122	3,380,545	127
Yeast (Dried)	829	163	950	194	578	253	1,141	345	807	237
Corn-Chopped	7,147	54	5,403	57	8,899	74	14,295	105	9,872	99
Oats-Crushed, Oats, Groats	9,108	85	6,250	103	8,396	109	8,834	149	8,004	158
Mixed Grain	14,474	41	11,506	68	10,475	96	15,595	129	12,848	139
Wheat Germ	577	120	755	110	1,540	138	974	184	1,067	198
Gluten	27,583	69	31,689	69	31,209	104	33,239	136	39,511	143
Gluten Meal	10,468	108	11,379	118	17,660	169	14,890	172	11,717	156
Malt Sprouts	11,410	54	14,140	56	13,257	91	14,919	108	14,353	101
Soybean Flour	-	-	4,256	179	10,649	304	21,128	222	20,397	206
Other Grain & Grain By-Products	3,516	23	2,545	91	3,969	131	16,047	120	32,305	126
Sub-Total	85,112	69	88,873	82	106,632	133	141,062	147	150,881	143
Grain By-Products (Bran, Shorts, Middlings)	319,037	54	295,191	59	297,474	91	354,949	113	367,025	112
Total	3,789,226	53	3,892,371	56	4,010,049	89	4,389,501	122	3,898,451	126

Grain Products	1976		1977		1978		1979		1980	
	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne	tonnes	$/tonne
Wheat	610,327	131	646,662	116	822,505	113	948,739	133	879,654	157
Barley	1,038,449	112	1,073,807	100	1,231,666	90	1,452,043	104	1,520,237	133
Corn	1,295,494	118	1,413,430	106	1,465,737	112	1,582,686	133	1,710,116	154
Flaxseed	807	227	193	228	890	283	1		1	
Oats	353,127	111	389,547	99	369,954	98	367,468	113	391,248	134
Peas	1,836	193	2,232	265	3,100	244	6,123	171	1	
Rice										
Rye	10,727	91	41,985	99	28,213	102	1	1	1	
Buckwheat										
Whole Grains	48,495	97	43,825	85	26,400	90	37,002	101	41,491	124
Screenings	157,804	89	198,392	90	183,078	81	206,290	89	216,467	103
Seed (Clover, Millet, Sunflower)	7	286	-		-		-	-	-	
Sub-Total	3,517,073	116	3,810,073	105	4,131,543	104	4,600,351	121	4,759,213	144
Yeast (dried)	602	271	1		1		1		1	
Corn - Chopped	4,223	58	4,350	130	5,303	130	19,074	138	195,128	119
Oats Crushed, Oats, Groats	8,236	171	8,714	169	11,705	181	14,555	210	13,328	238
Mixed Grain	19,370	114	6,997	125	11,364	120	8,627	152	15,955	168
Wheat Germ	1,830	133	853	211	1		1		1	1
Gluten	34,927	137	38,326	139	45,418	138	44,770	161	32,994	172
Gluten Meal	10,636	190	13,686	241	14,533	251	14,990	305	30,450	262
Malt Sprouts	14,588	120	12,013	120	10,375	110	11,484	152	10,762	142
Soybean Flower	23,463	226	7,660	293	6,478	340	34,522	303	27,337	334
Other Grain and Grain By-Products	15,000	176	24,943	104	13,268	136	-	-	-	-
Sub-Total	132,875	158	117,542	153	118,444	162	148,022	243	325,954	208
Grain By-Products (Bran, Shorts, Middlings)	362,397	113	324,308	111	291,172	107	311,723	133	375,390	155
Total	4,012,345	121	4,251,923	106	4,541,159	111	5,060,096	124	5,460,557	148

Source: Statistics Canada

APPENDIX 12

CANADA

SOYBEAN PRODUCTS, IMPORTS AND EXPORTS

APPENDIX 12

CANADA

SOYBEAN PRODUCTS, IMPORTS AND EXPORTS

	1972		1973		1974		1975		1976	
	tonne	$/tonne	tonne	$/tonne	tonne	$/tonne	tonne	$/tonne	tonne	$/tonne
Import Oil, Cake & Meal	222,147	119	191,349	243	277,443	183	294,361	184	348,774	200
Import Soybeans	308,490	127	231,792	217	390,792	232	385,107	224	418,926	205
Total	530,637		423,141		668,235		679,468		767,700	
Export Oil cake & Meal	88,930	106	112,827	169	115,529	152	58,994	160	62,704	180

	1977		1978		1979		1980		1981	
	tonne	$/tonne	tonne	$/tonne	tonne	$/tonne	tonne	$/tonne	tonne	$/tonne
Import Oil Cake & Meal	351,306	257	412,661	250	464,561	283	403,840	280	389,765	307
Import Soybeans	317,973	311	324,447	281	35,109	307	476,582	298	373,962	308
Total	669,279		737,108		499,670		880,422		763,727	
Export Oil Cake & Meal	45,589	236	48,307	257	22,597	300	78,315	327	50,667	357

Source: Statistics Canada

APPENDIX 13

CANADIAN DISPOSITION OF PRINCIPAL GRAINS - ANIMAL FEED, WASTE AND DOCKAGE

APPENDIX 13 CANADIAN DISPOSITION OF PRINCIPAL GRAINS - ANIMAL FEED WASTE AND DOCKAGE

Grain/Year	71/72	72/73	73/74	74/75	75/76	76/77	77/78	78/79	79/80	80/81
					tonnes					
Wheat	2,047.5	2,060.8	1,918.2	1,699.4	1.769.9	2,036.5	2,086.2	2,346.8	2,444.7	2,210.3
Oats	5,225.6	4,771.6	4,863.9	3,690.6	3,759.5	3,933.2	3,594.3	3,532.9	3,250.5	2,872.0
Barley	6,052.3	6,079.2	6,276.2	5,317.7	5,647.2	5,361.3	5,400.9	6,141.6	6,469.9	5,781.3
Rye	101.6	168.9	106.4	158.6	149.5	133.1	84.9	113.2	122.2	110.7
Flaxseed	78.6	69.2	49.2	-	-	-	-	-	-	-
Rapeseed	172.8	218.2	160.6	162.8	162.0	105.2	179.4	279.0	346.3	254.3
Corn	-	-	-	-	-	3,541.4	3,465.3	3,776.9	4,727.7	4,940.3
Total	13,678.4	13,137.9	13,474.5	11,029.1	11,488.1	15,110.7	14,811.0	16,190.4	17,361.3	16,168.9

Source: Statistics Canada

APPENDIX 14

CANADIAN SHIPMENTS BY FEED INDUSTRY

APPENDIX 14

CANADIAN SHIPMENTS BY FEED INDUSTRY

Commodity	1971		1972		1973		1974		1975	
	tonne	$/tonne	tonne	$/tonne	tonne	$/tonne	tonne	$/tonne	tonne	$/tonne
Macro Pre-Mixed	158,481	159	154,353	188	136,702	289	159,280	296	150,922	249
Complete Feeds	4,104,222	90	4,118,970	97	4,549,535	142	5,137,073	168	4,678,495	171
Chopped Grain	418,220	49	406,361	50	339,554	88	343,190	128	282,758	140
Dehydrated Grass Meals	75,766	49	116,770	45	137,654	68	176,146	82	183,104	86
Sundried Grass	-	-	9,925	48	26,230	61	13,606	74	16,721	75
Total	4,756,689	88	4,806,379	94	5,189,675	140	5,829,295	165	5,312,000	168

Commodity	1976		1977		1978		1979		1980	
	tonne	$/tonne	tonne	$/tonne	tonne	$/tonne	tonne	$/tonne	tonne	$/tonne
Macro Pre-Mixed	157,065	283	151,628	297	159,735	320	141,673	336	166,446	351
Complete Feeds	4,777,299	174	5,023,294	176	5,364,267	181	5,936,426	204	6,384,797	227
Chopped Grain	314,398	114	209,307	120	186,794	127	170,916	148	142,675	206
Dehydrated Grass Meals	180,892	93	217,830	87	215,511	92	243,606	100	246,263	119
Sundried Grass	25,640	73	29,541	83	23,532	67	22,121	75	37,155	89
Total	5,455,294	171	5,635,600	173	5,949,839	180	6,514,742	202	6,977,336	225

Source: Statistics Canada

APPENDIX 15

CANADIAN FEED GRAIN - PRICES PAID TO PRODUCERS

$ PER TONNE

APPENDIX 15

CANADIAN FEED GRAIN - PRICES PAID TO PRODUCERS

$/tonne

Feed Grain		71/72	72/73	73/74	74/75	75/76	76/77	77/78	78/79	79/80	80/81
Wheat	#3 Utility	47.18	69.89	143.52	134.04	118.53	95.94	90.15	118.87	126.82	167.71
Oats	Extra #1	41.50	69.38	112.17	108.28	106.34	85.59	75.22	87.81	85.00	129.29
	1 Feed	40.85	68.73	111.53	106.99	105.69	84.29	74.57	85.40	68.00	125.39
	2 Feed	38.90	66.79	109.58	105.04	103.75	87.35	71.33	83.45	64.00	123.22
Barley	1 Feed	37.20	67.06	118.96	107.01	103.80	91.40	88.39	91.08	107.47	106.55
	Designated Malting	-	-	-	-	156.39	143.99	102.64	116.92	165.44	204.28

Source: Statistics Canada

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Victoria, 1983

Volume

3

Market Assessment for Poplar Products

VOLUME 3 OF 3

PREPARED FOR GOVERNMENTS OF:

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ALBERTA
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The responsibility for the content of this report is the consultant's alone, and the conclusions reached herein do not necessarily reflect the opinions of those who assisted during the course of this investigation or the Federal and Provincial governments which funded the study.

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INTRODUCTION

This is the final volume of the report "Market Assessment for Poplar Products" which embraces potential uses for poplar species* in the following sectors:

a) pulp, paper and related products such as pulp logs and chips,

b) chemicals and animal feeds,

c) dimension lumber and solid wood specialty products,

d) composite wood products such as plywood, laminated veneer lumber, waferboard, oriented strand board, fibreboard, hardboard, coreboard and thin particleboard,

e) energy.

Volume two of the series covered groups (a) and (b) above, while (c), (d) and (e) are the subjects of this volume.

The scope of the study was confined to markets and marketing of poplar-based products but, in most cases, the major market constraints were found to be imposed by economic and technical factors and, therefore, for the sake of clarity discussions of these factors have been included in the appropriate sections.

Because of the physical characteristics of the poplar species, the economics of manufacture suggest that the various potential production processes must be linked together to the greatest degree possible. This thought underlies many of the conclusions reached by Carroll-Hatch (International) Ltd. (CHI) and forms a link between the three volumes of this report.

---

*Although several species of poplar occur in Canada, the most common in western Canada and the species included in this study are: P.tremuloides (trembling aspen), P. balsamifera (black or balsam poplar) and, P. trichocarpa (black cottonwood).

POPLAR LUMBER

Introduction

This section of the report presents an assessment of the existing and potential markets for poplar lumber. As will be shown later, despite the fact that poplar lumber has gained world-wide recognition as an acceptable building or fabricating material, actual consumption has never reached significant quantities in any world market. The reasons for the low usage factor are a direct result of the natural characteristics of poplar and are thus related more to technical than to market considerations. Since the technical aspects exert a significant influence on the marketability of poplar lumber, discussion of these characteristics has been included in the appropriate sections of this report.

Sources of information for the material presented in this section included interviews with lumber producers; furniture, cabinet, pallet and container manufacturers; agents, wholesalers and retailers; transportation companies; government and private agencies; and research and development institutes. Field interviews were conducted in the major market areas of North America, Southeast Asia, Japan and western Europe.

A significant portion of the time allocated to material preparation was expended on the assembly and analysis of previously published reports and studies. Over the past decade or more, the manufacture and processing of poplar lumber has been the subject of extensive research and development programs in North America. Extracting relevant data from the wide range of published findings was considered an essential element of this study.

This review of the market for poplar lumber examines both regional and end-use markets for all lumber - softwood and hardwood - because the total lumber market in effect represents the potential market for poplar lumber. Mechanics of distribution are discussed, as are trade inhibitors, price relationships and probable future demand. Conclusions based on market analysis and technical constraints are made and, from these, suggestions regarding further development programs are presented.

Product Selection

Although considerable overlap does occur, in general, all lumber flows to one of two major end-use markets - construction and industrial. Construction includes all building and building-related applications and industrial includes secondary manufacturing operations such as furniture, cabinet, pallet, and crate production.

Poplar lumber has been, and continues to be, used in both of these end-use markets, although its use in construction has been restricted almost entirely to vertical house framing members (studs). The limited acceptance by the construction industry appears to be related more to lack of supply of poplar lumber in adequate, consistent quantities at competitive prices rather than to strong end-user resistance. In other words, field interviews revealed no strong reaction, either negative or positive, regarding poplar lumber as a structural material. However, discussions with poplar lumber manufacturers indicate that the relatively small average diameter of most western Canadian poplar stands combined with unpredictable, but usually high, decay and other negative quality characteristics, tends to reduce the lumber recovery factor for poplar well below that for competitive species such as spruce, pine and fir. These species dominate the construction market and, under present production techniques, in order to compete economically in this market a poplar lumber producer must either develop profitable markets for the excessive volumes of residue material generated or use this for secondary products or fuel.

Confirming statistical data are not available but there appears to be little doubt that industrial applications account for virtually all of the poplar usage in all world regions. Even in industrial applications, however, poplar has been found suitable primarily for utilitarian purposes such as crate or pallet manufacture or for those furniture parts for which neither strength nor appearance are considered important. Techniques which would provide the basis for significantly increasing poplar lumber's market share have been developed and the following discussion on the size and location of the overall lumber market is therefore of direct interest to this study.

Regional Markets

As one of the oldest and most well-established fabricating materials in the world, lumber has achieved commodity status in the marketplace, and any addition to existing capacity would be forced to capture a share of the established market. For this reason, world and regional trends in lumber usage are of major importance to this study and are examined briefly in this section.

Until the advent of structural grade plywood and other panel products, competition in the lumber market came only between species or between regions. As shown in Table I and Figure I, however, panel products have undoubtedly exerted a major influence on the lumber production growth rate within the past decade or so.

TABLE I

WORLD PRODUCTION OF LUMBER AND WOOD BASED PANELS, SELECTED YEARS

(million cum)

Product	1950		1960		1970		1980	
	Vol.	%	Vol.	%	Vol.	%	Vol.	%
Lumber	265	96	343	92	413	86	439	81
Panel Products	12	4	29	8	70	14	102	19
Total	277	100	372	100	483	100	541	100

Source: FAO, Yearbook of Forest Products, 1960 & 1980.

Over the period shown, the share of total market (production taken as a general measure of market) accounted for by panel products increased from 4 to 19%. This reflects an average annual rate of growth of approximately 7.5% for panel products as compared with 1.5% per annum for lumber over the entire period covered. The rate of increase for both product lines declined sharply between the first and last decades shown. Rate of growth for panel products declined from 9% to 4% per annum and that for lumber fell from 2.6% to 0.6%. It should be noted, however that even a modest increase of 0.6% per annum based on production levels for 1980 equates to the output of approximately 15 international scale sawmills.

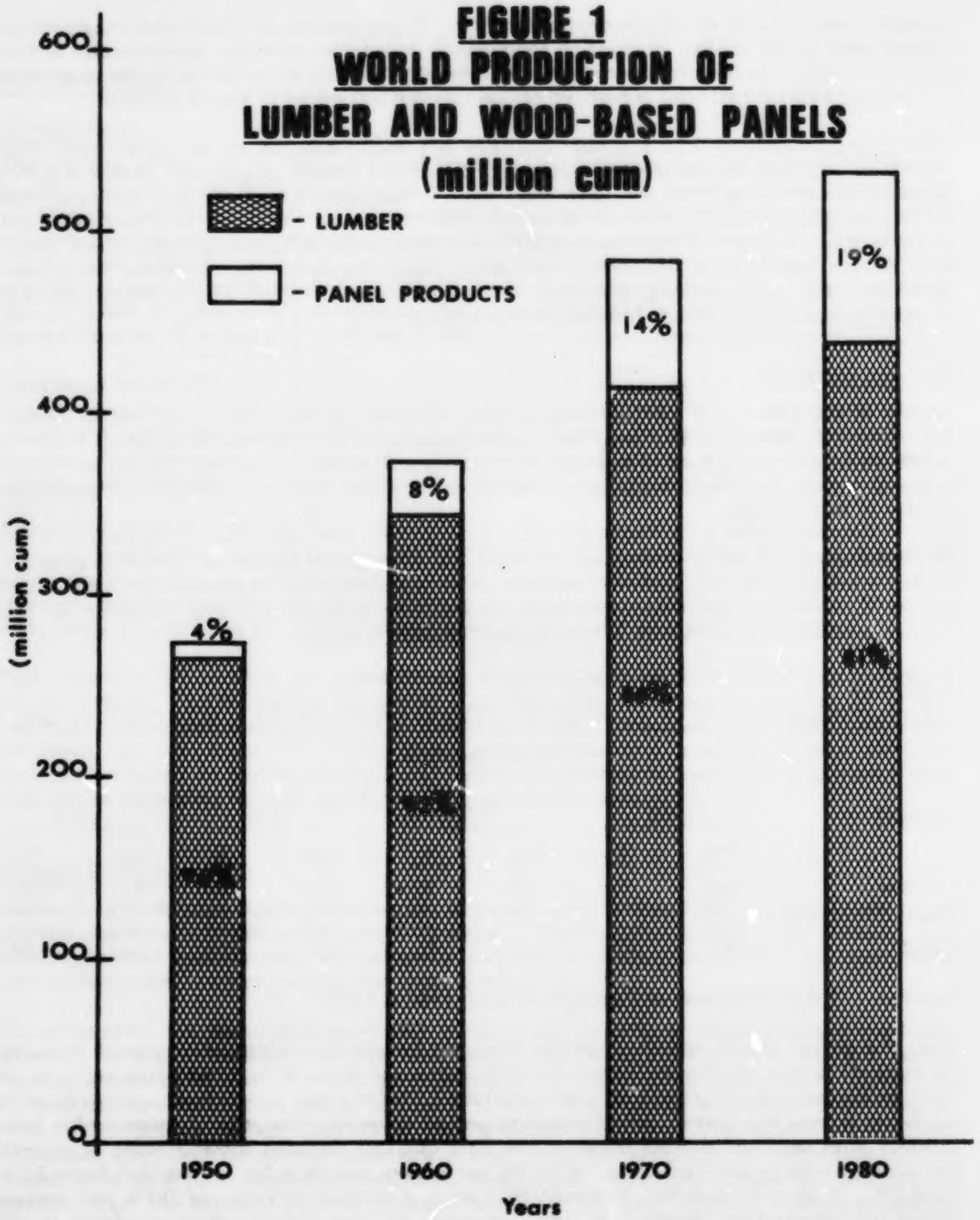


FIGURE 1
WORLD PRODUCTION OF
LUMBER AND WOOD-BASED PANELS
(million cum)

SOURCE: FAO Yearbook of Forest Products, 1960 & 1980

Poplar lumber flows to both the traditional softwood and hardwood markets but is generally regarded as a hardwood in most market regions. Table 2 shows the relative growth rates of softwood and hardwood lumber between 1950 and 1980.

TABLE 2

WORLD SOFTWOOD AND HARDWOOD LUMBER PRODUCTION, SELECTED YEARS

(million cum)

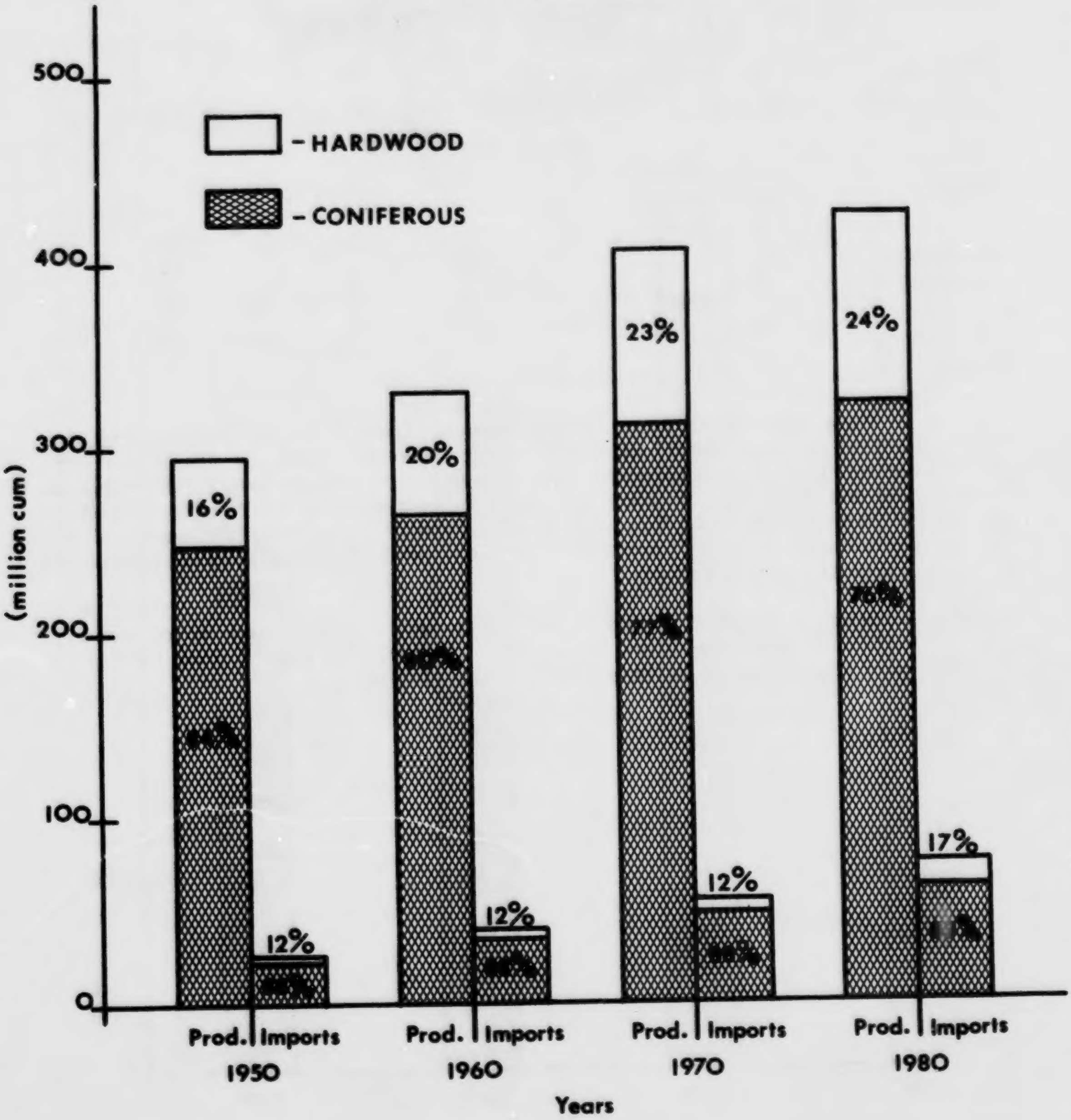
Species	1950		1960		1970		1980	
	Vol.	%	Vol.	%	Vol.	%	Vol.	%
Softwood	246	84	263	80	312	77	322	76
Hardwood	48	16	67	20	93	23	103	24
Total	294	100	330	100	405	100	425	100

Source: FAO, Yearbook of Forest Products, 1960 & 1980.

The market share taken by hardwood lumber increased from 16 to 24% between 1950 and 1980, reflecting an average rate of growth of approximately 2.5% per annum compared with 1% for softwood. Both categories enjoyed relatively strong growth rates during the 1960's - 2% and 3.3% for softwood and hardwood respectively - but suffered a sharp decline to less than 0.5% and 1% per annum during the 1970's. One of the causes of this decline is considered to be the impact of competitive products, notably wood-based panels and metal or plastic-based products.

Canada, in particular western Canada, relies very heavily on export markets for economic survival and world import trends are therefore of interest. The growth since 1950 in the world's lumber trade is shown in Table 3 and exhibited in Figure 2.

FIGURE 2
WORLD CONIFEROUS & HARDWOOD LUMBER PRODUCTION & IMPORTS
(million cum)



SOURCE : FAO Yearbook of Forest Products, 1960 & 1980

TABLE 3

WORLD IMPORTS, SOFTWOOD AND HARDWOOD LUMBER, SELECTED YEARS

(million cum)

Species	1950		1960		1970		1980	
	Vol.	%	Vol.	%	Vol.	%	Vol.	%
Softwood	23	88	35	88	49	88	62	83
Hardwood	3	12	5	12	7	12	13	17
Total	26	100	40	100	56	100	75	100

Source: FAO, Yearbook of Forest Products, 1960 & 1980.

Over the period shown, activity in world trade increased at an average annual rate of approximately 3.5%. The growth of the softwood component amounted to approximately 3.3% while hardwoods approximated 5%. For the objectives of this study, the important conclusion to be drawn from the data presented in Tables 2 and 3 is that world trade is increasing at a higher rate than world production. In the context of Alberta's and B.C.'s position as world suppliers, this is a significant trend. The higher rate of growth in trade relative to production is particularly pronounced in the hardwood lumber sector in which trade grew at approximately double the rate of production - 5% compared to 2.5%.

Relating this trade pattern to the B.C. and Alberta poplar resource indicates there may be a role for the species in world markets. Elsewhere in this study reference is made to the importance of hardwoods, in general, in the industrial lumber sector. Industrial lumber refers to the class of lumber, consisting of numerous grades, special lengths and cross-sectional sizes, in which the basis of grading each piece relates to the expected yield of smaller pieces or "cuttings" from the larger. Production of industrial grades is commonly found in the more efficient poplar sawmills which recognize the inherent natural defects in poplar logs. There are factors such as colour preference, strength (density) properties for furniture and chair parts, etc., for which poplar cannot meet all requirements. On the other hand, there are many uses such as hidden components in furniture, millwork, miscellaneous shapes and sizes in the lower valued industrial field where poplar could be fully acceptable from the point of view of technical suitability.

Western poplar could be produced for this market although, as noted later, the probable high percentage of waste developed in a mill would be a major problem.

Identification of the import markets contributing to the increase in world trade is also of interest to this study and Tables 4 and 5 show world trade flows for softwood and hardwood lumber respectively.

TABLE 4 DIRECTION OF WORLD TRADE, SOFTWOOD LUMBER

1980
(thousand cum)

From	To	Quantity	% of World Trade
Canada	U.S.	22,109	33
Finland	Western Europe (less U.K.)	3,738	6
Sweden	Western Europe (less U.K.)	3,422	5
Canada	Japan	2,578	4
Austria	Italy	2,477	4
U.S.S.R.	Western Europe (less U.K.)	2,176	4
Canada	United Kingdom	1,581	2
U.S.	Japan	1,496	2
Canada	Western Europe (less U.K.)	1,355	2
Finland	United Kingdom	1,285	2
U.S.S.R.	German DR	1,237	2
U.S.S.R.	United Kingdom	1,039	2
Sweden	United Kingdom	985	1
Others	Others	20,706	31
Total World Imports		66,184	98

Source: FAO, Yearbook of Forest Products, 1980

TABLE 5 DIRECTION OF WORLD TRADE, HARDWOOD LUMBER

1980
(thousand cum)

From	To	Quantity	% of World Trade
Indonesia & Malaysia	Singapore	1,334	11
Malaysia	West Europe	882	7
Yugoslavia	Italy	572	5
North America	West Europe	479	4
Malaysia	Thailand	473	4
Indonesia	Western Europe	444	3
United States	Canada	386	3
Singapore	Western Europe	357	3
Philippines	Western Europe	318	2
Germany	Western Europe	315	2
Brazil	United States	207	2
Romania	U.S.S.R.	200	2
Philippines	Japan	195	1
Canada	United States	167	1
Malaysia	Japan	159	1
Others	Others	6,179	49
Total World Exports		12,667	100

Source: FAO, Yearbook of Forest Products

The highly diverse nature of world trade in hardwood species relative to that for softwood is clearly evident. At least two-thirds of all softwood trade is confined to the highly industrialized regions but hardwood lumber trading includes all regions, developed or not. This is a result of many factors, including the ready availability of hardwood and the scarcity of softwood in most developing regions, with the consequence that hardwoods are well established in both the construction and industrial markets in those countries. It should be noted that most of the hardwood lumber traded is medium to high density, high-value material, while most of the lower quality lumber is used within the producing country.

Canada and Scandinavia obviously dominate as suppliers of softwood lumber and the U.S. constitutes the major world importer. Western Europe, however, which accounted for approximately 30% of world softwood imports in 1980, almost equals the U.S. as an import market. The only other significant importing region is Japan which accounted for approximately 6% of world trade.

The apparent importance of Singapore as an importing region for hardwood lumber is deceptive since nearly all of Singapore's imports are re-exported, with Singapore acting primarily as a staging or remanufacturing area. It is apparent that Southeast Asia constitutes the major world supply region for hardwood species and that western Europe represents the leading import market. The flow of hardwood from Yugoslavia to Italy is of particular interest to this study because poplar accounts for a significant portion of this trade. Italy probably leads the world in the utilization of poplar species, converting most of the material into pulp, but also utilizing reasonable volumes for the production of panel products (particleboard) and lumber. The lumber is used mainly in the manufacture of furniture.

Although western Europe has imported poplar lumber (all species of poplar, including aspen and cottonwood) from Canada, the trade has been of a minor, sporadic nature as have exports to Japan. The U.S. represents Canada's only reasonably significant poplar lumber market and the erratic nature of this market is demonstrated by the data in Table 6.

TABLE 6

POPLAR LUMBER EXPORTS TO THE UNITED STATES FROM CANADA

Year	Volume (cum)	Value (Thousand $)	Unit Value $per cum)
1970	14,772	570	38
1975	6,270	486	78
1976	6,533	463	71
1977	4,493	351	78
1978	8,536	708	83
1979	14,435	1,257	87
1980	14,712	1,286	87
1981	24,190	2,166	87
1982 (9 months)	19,392	1,829	94

Source: Statistics Canada

Data regarding the quality and sizes of the above exports are not available but, in the opinion of industry officials, nearly all of the lumber consisted of carefully graded material intended primarily for the eastern U.S. furniture market and is exported almost entirely from Ontario and Quebec.

As noted, Japan has imported only minor volumes of poplar lumber on an intermittent, experimental basis, but does import reasonably consistent volumes of poplar logs which are converted into lumber, veneer and pulp. Countries supplying these logs are shown in Table 7, together with the volumes supplied for selected years.

JAPAN

TABLE 7 IMPORTS OF POPLAR LOGS

(cum)

Year	Supplying Country			
	Canada	U.S.A.	U.S.S.R.	Total
1977	N	1,732	2,774	4,506
1978	N	2,317	N	2,317
1979	6,330	7,207	1,160	14,697
1980	25,700	11,113	526	37,339
1981	10,808	2,086	12,284	25,178
1982 (9 months)	2,426	1,237	5,977	9,640

Source: Japanese Ministry of Finance, Customs Clearance Statistics.

Note: "N" means insignificant.

Reportedly, all of the poplar from the U.S.S.R. is aspen, from the U.S., cottonwood and from Canada, both aspen and balsam poplar. All species are regarded by the Japanese as similar to each other and all are regarded as species suitable, in lumber form, only for utilitarian uses such as manufacture of pallets and packing cases.

The sharp increase in imported logs from Canada reflects several shipments of aspen (and some cottonwood) imported by Japanese organizations on a trial basis. Lumber, veneer and pulp were all produced from these shipments and the conclusions reached regarding lumber are summarized:

1. Lumber recovery ratio is very low relative to other species.
2. Degrade resulting from drying and secondary manufacturing is very high.
3. Lumber finishing (paint, varnish, and others) costs are relatively high because more applications of coating material are required than for other species.
4. The ratio of recovery of high-grade furniture quality material is unacceptably low.

The above results more or less coincide with processing experience in North America and are hardly surprising since, as in North America, traditional sawmilling techniques, which have proven to be only marginally compatible with poplar's characteristics were employed. In any event, experience with western Canadian poplar lumber is very limited in Japan and a major development program would be required to capture a share of the lumber market, assuming adequate supplies were available. A similar statement would be true for all other overseas export markets. Although various species of poplar are reasonably well-known in most markets, lumber produced from western Canadian poplar is virtually unknown and a major introductory program would be required to develop reasonable market shares.

Within North America, although poplar has been accepted in the construction market as a competitor to softwood, the acceptance has been limited and the hardwood market would probably offer the best potential for poplar lumber. Trends in this market are shown in Table 8.

TABLE 8

HARDWOOD LUMBER PRODUCTION AND APPARENT CONSUMPTION CANADA AND UNITED STATES, SELECTED YEARS

(thousand cum)

	Canada		United States	
	Production	Consumption	Production	Consumption
1950	1,324	880	13,500	13,623
1960	950	841	14,851	15,065
1970	1,326	1,263	16,846	17,368
1975	973	766	13,858	13,734
1977	1,045	1,033	15,567	15,782
1978	1,333	1,597	15,959	15,785
1979	1,166	1,491	17,207	17,346
1980	1,429	1,851	17,039	16,829

Source: FAO, Yearbook of Forest Products

Note: Apparent consumption = production plus imports minus exports.

The data in Table 8 show clearly that production in Canada has not increased over the past 30 years, although consumption has increased at an average rate of approximately 2.5% per annum. In the U.S., both production and consumption have increased at almost identical rates - approximately 1% per annum over the period shown and, in general, have remained reasonably well in balance over the past several years. Consumption in Canada, however, appears to have exceeded production fairly consistently.

Despite the apparent supply deficiency which exists in Canada, it is considered unlikely that poplar could be used to satisfy the excess demand. Poplar lumber is regarded as a low-value, low-quality hardwood suitable only for utilitarian applications and the hardwood currently imported into Canada to make up the supply shortfall consists almost entirely of high-value, high-grade, well-established hardwood species supplied primarily from the U.S. and Southeast Asia. Poplar's almost negligible share of total Canadian hardwood production is shown in Table 9.

TABLE 9 CANADA
POPLAR AND TOTAL HARDWOOD LUMBER PRODUCTION
(thousand cum)

Year	Total Hardwood Production	Poplar Production	Poplar % of Total
1960	950	54	5.6
1970	1,326	27	2.0
1975	973	39	4.0
1976	1,170	39	3.3
1977	1,333	48	3.6
1979	1,166	65	5.6
1980	1,429	67	4.7

Source: FAO, Yearbook of Forest Products; Statistics Canada

Production of poplar lumber obviously emulated the almost stagnant nature of total hardwood production in Canada. The peak of poplar production of 148,000 cum was attained in 1973 with the advent of a poplar stud mill in Alberta which ceased production after a three year operation. Virtually all poplar lumber is now produced in Ontario and Quebec, with relatively minor quantities being produced intermittently in Manitoba, B.C., and Alberta.

Regional distribution statistics of Canadian poplar lumber shipments are not available but industry officials estimate that, except for relatively minor quantities used in Alberta and Manitoba for pallet and container fabrication and to a lesser extent in furniture production, domestic consumption of poplar lumber occurs almost entirely in the heavily industrialized areas of Ontario and Quebec.

In summary, reasonable conclusions seem to be that western Canadian produced poplar lumber is virtually unknown outside of North America and that in North America usage is, in the main, confined to eastern Canada and to the eastern and mid-west regions of the U.S. It is equally clear that production (hence marketing) of poplar lumber in Canada has been virtually stagnant for the past decade or more.

End - Use Markets

Poplar lumber has gained acceptance in both the construction and the industrial markets. This acceptance has been very limited, however, and poplar normally is the first casualty in a market downturn. In the construction market, lack of consistent supply, lack of a range of sizes and grades, and prices which do not relate to market conditions are all noted as reasons for the low degree of usage. Virtually all poplar lumber produced for the building market has been confined to stud size and quality (vertical support members), and although studs account for the major portion of lumber used in residential construction (the largest single end-use for lumber), species other than poplar are well-established, competitively priced and apparently preferred by users. Poplar is perceived as a low-strength building material but the primary reason for its low usage factor appears to be non-availability and higher price during market downturns. These factors are directly related to the cost of producing poplar which, according to lumber producers in western Canada, can be up to 30% higher than that for spruce/pine/fir (SPF). These cost relationships are reportedly the result of the high incidence of decay in poplar as well as the high proportion of sweep, crook and other malformations encountered in poplar logs. In any event, it is quite clear that the reasons for the minimal use of poplar lumber by the construction industry are more attributable to technical and economic rather than to market factors. In other words, if poplar lumber could be supplied on a consistent basis in significant quantities and at competitive prices, there is no doubt that an appropriate share of the market could be secured.

Data showing the end-use distribution of poplar lumber in North America are not readily available. However, industry officials estimate that pallet, container and other utilitarian industrial uses account for the major proportion and that furniture and cabinet fabrication account for the next most significant position, with construction accounting for the remaining minor volumes. France is one of the few countries for which end-use data are available and the distribution of poplar lumber for 1978 is shown in Table 10.

TABLE 10 FRANCE

END-USE DISTRIBUTION, POPLAR LUMBER, 1978

End-Use	Volume (thousand cum)	%
Crates & Containers	400	65
Furniture	120	19
Construction	70	11
Other	30	5
Total	620	100

Source: "le peuplier, aujourd' hui et demain", Institut Pour le Developpment Forestier, 1980.

End-use distribution in France is thought to be very similar to the estimated distribution pattern developed in North America. Although Italy is recognized as the main poplar consuming country in Europe, no specific end-use data are available. Based on estimates provided by knowledgeable Italian officials, it appears that poplar logs constitute the major portion of all poplar imports and most of these flow to either the pulp or particleboard industries. This estimated distribution of poplar log relates very closely to that experienced in both Canada and the U.S. for which specific data are available and shown in Table 11. The data in the table refer to aspen only. Other poplar species are discussed later.

TABLE 11 END-USE ASPEN LOG CONSUMPTION, CANADA AND U.S.

(thousand cum)

End-Use	Canada		U.S.	
	Volume	%	Volume	%
Pulp & Paper	1,246	45	4,000	73
Particleboard	1,007	36	800	14
Plywood	382	14	N	N
Lumber	118	5	703	13
Roundwood Exports	6	N	5	N
Total	2,759	100	5,508	100

Source: "Poplar Utilization Trends & Prospects", Forintek Canada Corp.
U.S. Forest Service, North Central Forest Experiment Station.

Notes: U.S. data are based on conversion factors of 3.48 cum per MFBM of International 1/4" Log Rule for sawlogs and 2.12 cum (75 cubic feet) of solid wood per cord of pulpwood for pulp and particleboard. Particleboard includes waferboard and oriented strand board.

"N" means insignificant.

Obviously a much higher proportion of the total aspen used in the U.S. flows to pulp and lumber than in Canada. Pulp use is discussed in another section of this report but, in the case of lumber, several reasons for the apparent higher proportion used were obtained. The two reasons considered to be important are:

1. Proximity to the large, varied industrial markets of the U.S. north-central, mid-west and eastern seaboard regions.

2. Less competitive pressure from softwood species than in Canada.

In addition to the aspen volumes shown in Table 10, approximately 250,000 cum of cottonwood lumber were also produced in the U.S. in 1980, thus bringing the total poplar lumber produced in 1980 to 953,000 cum or almost 9 times that produced in Canada. On a population basis, this ratio appears reasonable but would also indicate that poplar lumber has achieved a realistic degree of acceptance in the U.S. but not in Canada.

Virtually all of the aspen is produced in the "Lake States" - Michigan, Wisconsin and Minnesota - and most is also used in the same region. In other words, transportation costs are not a critical factor in the economics of distribution as would be the case in B.C. and Alberta. Most of the cottonwood is produced in the mid-west states of Missouri, Indiana and Iowa and most is also consumed either within the same region or in close proximity.

In the industrial market, poplar has been accepted as a suitable species for pallets, containers and furniture production. Precise data are not available but poplar usage in furniture manufacture is reported to be relatively minor with applications confined to uses where neither strength, nail-holding nor appearance are important. In Alberta, Manitoba, Ontario and Quebec, poplar is well-established in the pallet industry and it is apparent that this end-use constitutes one of the more stable markets for poplar in Canada. Most pallets in B.C. are manufactured from low-grade softwood lumber, with minor volumes of alder also used.

The Pacific Northwest represents the industrial market region logically available to lumber producers in Alberta and B.C. and a recent study has identified the end-use markets presently serviced by hardwood lumber producers in this region. The results of the study are shown in Table 12.

TABLE 12 ESTIMATED TOTAL VOLUME AND COST OF PACIFIC NORTHWEST HARDWOOD LUMBER USED IN THE INDUSTRIAL MARKET

Industry Sector	Hardwood Used		
	Volume (cum)	Cost ($per cum)	Total Cost ($)
Case Goods	147,418	189	27,862,000
Cabinets	83,552	186	15,540,672
Furniture	79,712	122	9,724,864
Pallets	26,547	111	2,946,717
Novelties	6,446	307	1,978,922
Total	343,675		58,053,175

Source: "Economic Value of The Pacific Northwest Hardwood Industry in 1977", Forest Research Laboratory, Oregon State University, December 1978

Note: "Cost" shown in Table 12 means cost delivered to secondary manufacturing plants.

The U.S. northwest hardwood lumber industry is based almost entirely on red alder but the market distribution would be similar for comparable grades of poplar. Virtually the entire production was sold into the southwest and northwest regions of the U.S., with minor volumes exported to B.C. and Alberta. The low volume of sales to the pallet industry reflects the strong competition from low-grade softwoods readily available in the Pacific Northwest region.

In overseas markets, poplar has achieved virtually no acceptance in the construction market (codes usually preclude this as will be discussed later) and extremely low acceptance in the industrial market. In the two major markets, Japan and Korea, poplar is used primarily for the manufacture of chop-sticks and match-sticks, with minor amounts being used for pallet and case manufacture.

Although shipments of poplar lumber have been made from time to time to overseas markets, in particular Japan, these have been on a sporadic, non-consistent basis and, in the opinion of overseas buyers, have not provided the basis for an adequate assessment of potential market acceptance. In other words, the limited use of poplar in overseas markets can by attributed more to a lack of supply than to an adequately measured market response.

As noted previously, poplar lumber has achieved a degree of acceptance in Europe but the volumes are minor and competition from other species and domestic poplars would be extremely sharp. For these reasons, attempting to identify new or expanded use of poplar lumber is considered to be futile. Production of poplar lumber must be taken seriously in the supplying region and the various grades, sizes and qualities which could be produced must be shown to be available on a consistent basis in quantities and prices which could compete for appropriate end-use markets.

Quality Standards

Poplar species are included in all of the major grading codes in North America. In Canada, grading and quality standards are established primarily by the "Standard Grading Rules for Canadian Lumber" published by the National Lumber Grade Authority and, in the U.S., rules issued by the National Hardwood Lumber Association, the Northeastern Lumber Manufacturers Association and the Western Wood Products Association have established the quality standards for domestic and imported lumber. There are other local or regional codes which govern lumber use in specified regions but nearly all accept the recommendations of the major codes.

For a variety of technical reasons, studs represent virtually all construction grade poplar lumber produced. Minor quantities of 5cm x 15cm and 5cm x 20cm in lengths from 2.5 to 5 m are produced in eastern Canada but almost none in western Canada. For this reason, poplar construction lumber use has been confined to vertical support members and general utility use on construction sites. In general, poplar has a very high moisture content when logged and all poplar lumber for construction use must be dried before shipment. Kiln drying is necessary to not only avoid excessive transportation costs but also to avoid warping and twisting which occur frequently in poplar lumber as it is air dried.

Poplar intended for the furniture or cabinet markets must also be kiln-dried but poplar lumber can be (and usually is) used in the green state for pallet construction. Although a proportion of lumber used in pallet construction is 5 and 7.5 cm thick, most of the lumber used (an average of approximately 0.06 cum per pallet) is in the form of boards 2.5 cm thick which are nailed or stapled green to the support stringers and remain level and straight during the drying process. Although poplar is used extensively for pallet construction in all parts of Canada, the specifications published by the Canada Pallet Council, Toronto, allow only high density species and thus effectively preclude poplar. However, major buyers of pallets rely more heavily on established supply sources than on published specifications and, except in the case of pallets intended for a number of re-uses, poplar lumber is widely used in pallet construction.

A major factor inhibiting the use of poplar, or any species, in furniture manufacture is the range of sizes which must be produced to satisfy the market's needs. The number of sizes required by the overall industry has been estimated to be well in excess of 5,000. Even for selected segments of the industry, such as wooden cabinets, the number of sizes required is extremely large. This factor, combined with the long distances from Alberta or B.C. to any of the major furniture producing regions in Canada or the U.S., has severely restricted supply to this major wood-using industry. This applies not only to poplar but to all western hardwood and softwood species. Research and development projects have shown that, using appropriate conversion techniques, a high proportion of the lumber recovered from western poplar could be further manufactured to sizes acceptable to a broad range of furniture and cabinet producers. This technology will be discussed briefly in a following sub-section.

The export of significant volumes of construction grade poplar lumber to overseas markets appears to be a very remote possibility. Japanese building codes are very restrictive and are not likely to be amended. Despite the fact that radiata pine has been imported for at least 10 years from New Zealand and Chile, the species has not yet been approved as an acceptable material for construction purposes under the Japanese building code. Similarly in western Europe and in Southeast Asian countries, poplar lumber is either completely excluded from building applications or is permitted subject to satisfying prescribed strength and stability requirements. As in North America, the ready availability of abundant supplies of well-established species militates against the acceptance of any non-established species.

A reasonable conclusion would be that the industrial market offers the most promising potential for western poplar lumber. Less demanding strength requirements, acceptability of relatively small sizes and a much more stable market are all benefits offered by this market relative to the construction market.

Competitive Products

In western Canada, the principal competitive products are the softwood species, in particular, the SPF category produced in both Alberta and B.C. These softwood species completely dominate the construction and the industrial market where special sizes or high strength values are required. SPF is also used for pallet construction during periods of low demand when market prices for SPF fall below the production costs of poplar lumber.

In eastern Canada, the major competition would be from established poplar producers as well as softwood lumber manufacturers. As noted in a previous sub-section, approximately 70% of all poplar lumber in Canada is produced in Ontario and Quebec. Most of the poplar produced is also consumed in these provinces or in adjoining U.S. states.

Competition in the U.S. stems from the same sources as in Canada: softwood lumber in the northwest and poplar in the northcentral and mid-west states. Southern pine production, which is increasing steadily, is an added source of competitive material in the U.S.

In discussing existing and potential sources of competition, the present low utilization of the total hardwood resource in the U.S. should be considered. A recent analysis of timber supply/demand balances completed in the U.S. showed that in 1976 the excess of annual growth over annual removals amounted to approximately 147 million cum. This excess is projected to decrease to 105 million cum by 1990 but, nevertheless, will still represent a substantial reserve of hardwoods. The hardwood stands are located in nearly all regions of the U.S. but the major reserves are in the northern and northwest states which account for approximately 70% of the excess annual supply.

This under-utilized hardwood resource, a significant proportion of which consists of poplar, has begun to receive more attention than in the past because, the study concluded, domestic softwood supplies will not be able to meet projected demand in the near future and the growing demand in the U.S. for fuelwood will add more pressure on supply than ever before. A reasonable conclusion would be that if a Canadian hardwood producer succeeded in developing a substantial market for hardwood lumber products in the U.S., the market could conceivably be acquired by a U.S.-based hardwood lumber producer better located, geographically, relative to the end-user.

Distribution Mechanics

Poplar lumber distribution follows the traditional lumber distribution system and, in general, flows from producer to end-user through a series of intermediaries. The exception is the flow of poplar to selected industrial accounts such as pallet producers, in which case, agreement generally is reached between producer and end-user.

Construction grade lumber usually follows the route, producer to wholesaler/distributor to retailer/end-user. Exceptions occur regularly but most lumber sold domestically follows the established pattern and poplar lumber is no exception.

Exports to the U.S. are sold either directly to a wholesaler or through an agent to either industrial accounts or wholesaler/distributors. Agents normally do not take title to the goods but often assume responsibility for payment of the goods as well as completing the necessary documentation.

Wholesalers normally assume legal and physical possession of goods, maintain adequate inventories and re-sell either to contractors, retailers or end-users. Import wholesalers may purchase from agents or directly from the producer, in which case, the wholesaler assumes responsibility for documentation, customs clearance and payment.

As a general rule, retailers do not buy directly from the producer but, rather, through a wholesaler. The modest quantities retailers usually require, added to the difficulty of securing payment from a wide-range of relatively small accounts, tend to discourage direct dealing from producer to retailer.

Over the past two decades or so, in both Canada and the U.S., nearly all of the major lumber producers have acquired control of their own distribution systems. The number of independent wholesalers has declined drastically and most confine their activities to local (as opposed to national or international) markets. Several of the major producers have extended their control to the retail level.

For overseas markets, lumber producers have established several co-operative shipping/marketing organizations which in turn sell either to agents or to wholesalers depending on the market. In the United Kingdom, for example, the export shipping groups have established their own wholesale distribution system, while in continental Europe selling through an agent is still an established custom.

The Japanese market could be serviced by a variety of well-established methods. One or more of the major trading companies could be selected, in which case all distribution within Japan would become the responsibility of the trading company. Alternatively, one or more agents could be selected, a method which would require marketing assistance for the producer within Japan. A third method would be to align with one or other of the established export shipping groups, in which case all shipping/marketing responsibility devolves to the shipping group.

In general, distribution methods in other Southeast Asian countries are similar to those in Japan, with the exception that the powerful major trading companies would not be present. However, each country has well-established distribution systems which should be analysed in depth to provide the basis for the selection of the most suitable method.

Transportation Considerations

Softwood lumber produced in western Canada has been marketed more or less routinely on a world wide basis, and has captured a significant share of all North American market regions. Except for intermittent periods, however, poplar lumber produced in western Canada has, for all practical purposes, been confined to markets in close proximity to the producing mill. There are several reasons for this restricted distribution pattern, one of the most important being the effect of transportation costs on the delivered price. For lumber of any species, the major domestic markets are concentrated in Ontario and Quebec and the relationship between rail transportation costs for poplar shipping points in eastern and western Canada to these markets are shown in Table 13.

TABLE 13 LUMBER/RAIL TRANSPORTATION RATES, JANUARY, 1983

($ per 100 lb. - 80,000 lb. minimum)

To: From	Winnipeg	Toronto	Montreal
Vancouver, B.C.	3.68	4.71	4.71
Fort St. John, B.C.	3.43	4.71	4.71
Edmonton, Alta.	1.51	3.86	3.86
Longlac, Ont.	1.94	1.40	1.65
Val d'Or, Que.	2.19	1.30	0.97

Source: Railway companies.

A substantial transportation cost advantage is obviously available to eastern Canadian shippers into the major markets of Toronto and Montreal. The rate differential of $2.89 per 100 lbs. (45.36kg) between Edmonton and Val d'Or in shipping to the Montreal area market amounts to approximately $72.00 per 1,000 fbm* ($30.00 per cum). This cost differential in relation to a current mill selling price of approximately $140.00 per 1,000 fbm ($60.00 per cum) for poplar lumber obviously seriously affects the ability of western producers to service the major eastern Canadian markets. Although Edmonton was selected for comparison purposes, western shippers would face a similar disadvantage to a greater or lesser degree when shipping from any location in Alberta or B.C. to any point in Ontario or Quebec. Conversely, transportation costs from eastern points into the reasonably large Winnipeg area market are not significantly higher than those from Edmonton and are considerably less than those from B.C. shipping points.

Road transportation has always accounted for a substantial portion of lumber shipments, particularly those made to local and domestic markets. Road rates are more flexible than rail rates and are more open to negotiation. Generalized road rate structures should therefore be accepted as guides only since actual site and volume-specific rates could vary considerably. Presently established road rates from selected shipping points to the major market areas are shown in Table 14.

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*Based on an assumed air-dry weight of poplar of 2,500 lbs. per 1,000 fbm. (1,134 kg per 2.36 cum).

TABLE 14 LUMBER/ROAD TRANSPORTATION RATES, JANUARY, 1983

($ per 100 lb. - 44,000 lb. minimum)

To: From	Winnipeg	Toronto	Montreal
Vancouver	3.69	4.13	4.13
Fort St. John	4.18	4.25	4.55
Edmonton	1.41	3.08	3.99
Longlac	1.98	1.24	1.70
Val d'Or	N.S.	1.12	0.92

Source: Transportation companies, rate schedules and quotations.

Note: "N.S." means no service and rate quotations are not available.
$/100 lbs. - 44,000 lb. minimum = $/45.36 kg - 19,958 kg min.

Western shippers obviously face the same cost disadvantages for road as for rail shipments. This applies even into the Winnipeg market. Localized shipments into Alberta and B.C. markets from a plant located in either province would, of course, enjoy a transportation cost advantage over shippers from other provinces. However, the competition in local markets stems from locally-produced softwood lumber and not eastern-produced poplar.

Rail transportation cost relationships to U.S. markets from various shipping points are shown in Table 15.

TABLE 15 LUMBER/RAIL RATES CANADA TO U.S., DECEMBER, 1982

$ 100 lbs. ($ per 45.36 kg))

To: From	Los Angeles	Phoenix	Houston	Chicago	New York
Vancouver	3.00	3.36	4.08	4.30	5.60
Edmonton	3.10	3.53	4.90	4.38	5.28
Longlac	5.10	5.10	4.11	2.36	3.19
Val d'Or	5.57	5.57	5.25	2.29	2.54
Hayward, Wisc.	4.32	4.52	2.58	1.27	3.87

Source: Transportation companies, rate schedules and quotations.

The above rates should be taken as indicative only since rail transportation costs to almost all regions of the U.S. are now based on a per car charge. The car charge is based on the rated carrying capacity of the car and any weight carried in excess (to specified limits) of this rated capacity is in effect carried at no cost. The density of most wood-based products is not high enough to benefit from the extra carrying capacity but waferboard is one exception. Currently, shippers are succeeding in loading up to 170,000 lbs. (77,112 kg) into a car rated and charged at 120,000 lbs. (54,432 kg). The conclusions to be drawn from the data in the above table are that, except for the California - Arizona regions, western Canadian shippers are at a distinct transportation cost disadvantage. Producers in the major poplar-based industries in the Lake States (represented by Hayward, Wisconsin) apparently have not as yet lobbied actively for lower rates into the California/Arizona market region. It is considered likely, however, that these would be granted rates at least equal to those from western Canada if strong representation were made to the transportation authorities.

As noted previously, an added concern in assessing the market potential offered by the California/Arizona region would be the substantial volumes of non-utilized hardwood species located in the northwest and Pacific coast areas of the U.S. Development of this resource appears to have been inhibited for the same reasons as those governing the use of western Canadian poplar, ie., an excess of readily available softwoods and the low quality of the hardwood resource. As in Canada, however, softwood timber has become scarcer, less accessible and more costly over the past decade or so and much more attention is now being directed towards economic utilization of the relatively untouched hardwood stands. Whether the quality of this resource would be adequate to support a significant sawmill industry is debatable, but the same manufacturing techniques which could be used for poplar could also be used for these mixed hardwood stands. In any event, this particular concern would have to be thoroughly investigated prior to any major investment decision being taken regarding poplar lumber production in western Canada.

Overseas transportation costs vary significantly depending on volumes contracted, type of vessel, method of charter (or negotiated single voyage rates) and a variety of other factors. Estimates of transportation costs for lumber to overseas markets ranged from $40.00 per cum to $55.00 per cum. For the purposes of this study, an overseas transportation cost (to Japan, Southeast Asia and western Europe) of $50.00 per cum will be assumed. This includes port charges, documentation and all handling costs.

A poplar lumber market as such does not exist in Japan or Southeast Asia. Furthermore, poplar lumber, which is generally not acceptable for structural purposes, would be acceptable only for the lower value products such as pallet, container and cable reel manufacture, and in these markets, New Zealand pine constitutes the major competition. The current price for the grade of pine for these uses is approximately $130.00 per cum discharge port which, after adjustment for sea transportation costs yields an FOB price of approximately $75.00 per cum. Obviously, at reported poplar lumber production costs in western Canada of $55.00 to $60.00 per cum, the margin remaining for inland transportation, storage and profit appears to be very narrow.

In summary, it is clear that the cost of transporting poplar lumber either within North America or to overseas markets should be analysed in depth prior to any investment decision being taken. There is no doubt that the location of a producing unit, the grade and size of lumber likely to be produced, and the return to be expected from residue disposal should all be analysed in detail before a logical decision could be reached regarding poplar lumber manufacture.

Price Relationships

Traditionally, lumber production in Canada has exceeded consumption by a very wide margin. In 1980 for example, production amounted to approximately 37 million cum and consumption to 14 million cum or 38% of total production. Canadian producers are, therefore, almost completely reliant on the export market and, consequently, world lumber prices exert more influence on mill prices than do domestic prices. This is true even though a major portion of Canada's exports go to the U.S., because prices in this market are also heavily influenced by world prices. Any analysis of markets and prices for potential additional poplar lumber capacity must therefore include a review of world prices and price trends. In this regard, world price trends are compared with those in Canada for all coniferous and hardwood species. For added comparison, the world price index for all commodities is also shown in Table 16.

TABLE 16 WORLD AND CANADIAN PRICE INDEX FOR ALL CONIFEROUS AND HARDWOOD SPECIES

(1970 = 100)

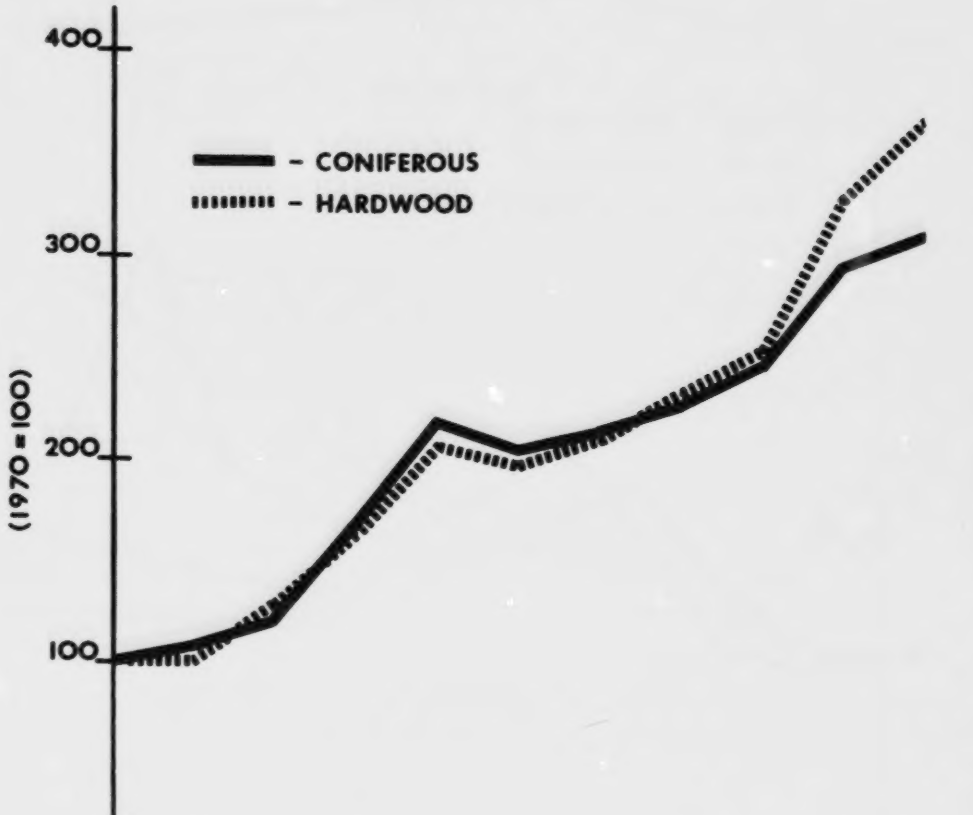
	World		Canada		All Commodities
	Coniferous	Hardwood	Coniferous	Hardwood	
1970	100	100	100	100	100
1971	107	100	109	106	95
1972	120	123	140	128	108
1973	168	163	183	140	165
1974	218	205	171	155	211
1975	203	198	160	153	173
1976	211	208	186	160	196
1977	227	229	217	172	236
1978	245	251	191	194	225
1979	293	326	309	234	262
1980	309	363	209	251	288

Source: FAO, Yearbook of Forest Products
Statistics Canada, Canadian Forestry Statistics
International Financial Statistics, IMF, 1981

Note: World index based on world export prices. Index for Canada based on producers shipments. Despite this difference in base price, the comparisons are considered valid since trends only are the basis for comparison.

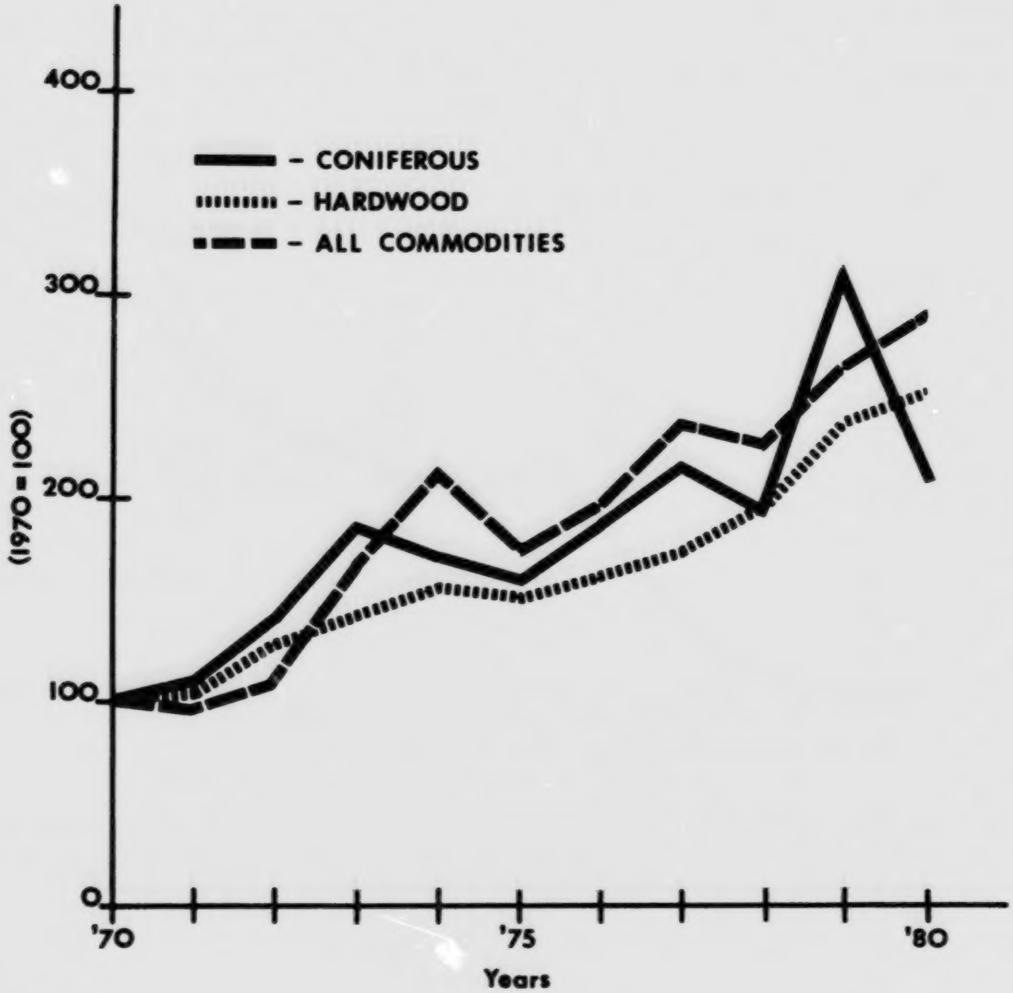
It is apparent that prices for Canadian lumber have not increased at the same rate as world commodity or world lumber prices. The more volatile nature of coniferous lumber prices relative to hardwood is also apparent as shown in the Figures 3 to 5.

FIGURE 3
WORLD PRICE INDEX FOR ALL CONIFEROUS AND HARDWOOD SPECIES
(1970 = 100)



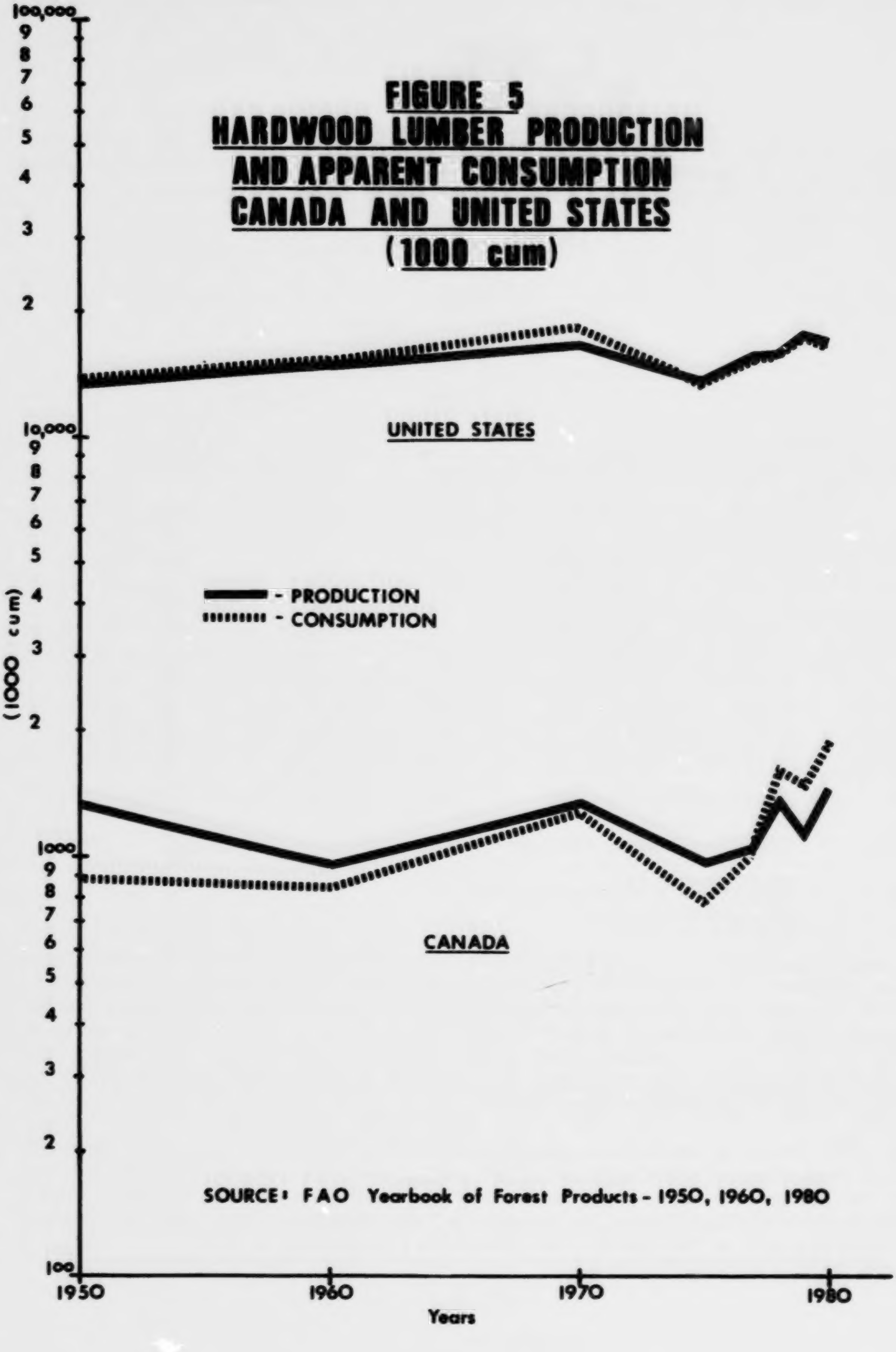
SOURCE: FAO Yearbook of Forest Products, 1980.
Canadian Forestry Statistics - Statistics Canada.
International Financial Statistics - IMF 1981.

FIGURE 4
CANADIAN PRICE INDEX FOR ALL CONIFEROUS AND HARDWOOD SPECIES
(1970 = 100)



SOURCE: FAO Yearbook of Forest Products, 1980.
Canadian Forestry Statistics– Statistics Canada.
International Financial Statistics – IMF 1981.

FIGURE 5
HARDWOOD LUMBER PRODUCTION AND APPARENT CONSUMPTION CANADA AND UNITED STATES
(1000 cum)



SOURCE: FAO Yearbook of Forest Products - 1950, 1960, 1980

In the construction market, poplar lumber must compete directly with the established coniferous species, in particular with SPF. To provide perspective and to compare price trends, shipments by volume and value of SPF and poplar lumber commencing in 1970 are shown in Table 17.

TABLE 17

CANADA
SPF AND POPLAR LUMBER
SHIPMENTS - VALUE AND UNIT VALUE
1970 to 1980

Year	SPF			Poplar		
	Volume	Value	Unit Value ($ per cum)	Volume	Value	Unit Value ($ per cum)
1970	10,963	349,344	32	27	926	34
1971	13,494	482,791	36	45	1,48	32
1972	16,320	760,945	47	86	2,437	28
1973	16,934	1,012,087	60	148	7,064	48
1974	15,834	862,669	54	108	5,043	47
1975	13,964	710,561	51	40	2,400	61
1976	17,574	1,019,836	58	39	2,082	54
1977	21,004	1,403,754	67	41	2,509	61
1978	22,194	1,839,406	83	48	3,262	69
1979	23,549	2,196,074	93	65	5,634	86
1980	22,446	1,911,498	85	67	5,682	85

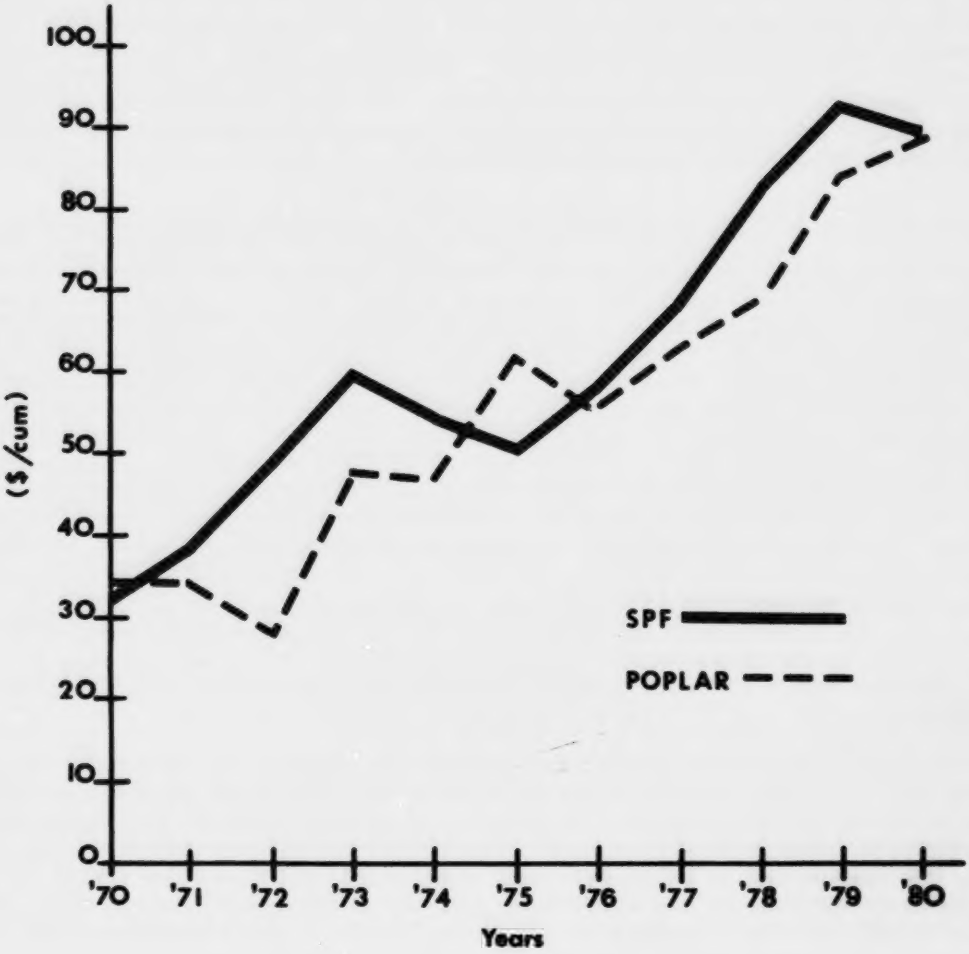
Source: Statistics Canada, Canadian Forestry Statistics

Note: Volume in thousand cum.
Value in thousand $.

Two major conclusions may be drawn from the data in Table 17. The first is that poplar lumber represents an insignificant proportion of the total lumber market (particularly in view of the fact that SPF represents only 50% of total lumber production) and is, therefore, highly vulnerable to market fluctuations, and the second is that the net sales return for SPF has, in general, been higher than that for poplar. However, both commercial experience and production cost trials have shown that costs of producing poplar are generally higher than those for SPF.

Since 1980, lumber prices have dropped steadily and by mid-1981 were lower than the costs of production for many sawmills. Plant selling prices for SPF, for example, declined from the $85 per cum average return for 1980 to about $60 per cum in 1982. Poplar lumber producers report that this selling price is equivalent to poplar production costs and that sales of poplar to the construction market have been virtually nil for all of 1982. A ten year trend is shown in Figure 6.

FIGURE 6
UNIT VALUE OF CANADIAN SHIPMENTS OF SPF AND POPLAR LUMBER
($/cum)



SOURCE: Canadian Forestry Statistics – Statistics Canada.

The current low market price for SPF has also had a negative effect on sales of poplar lumber to the industrial market. In the pallet fabricating industry, for example, in both western and eastern Canada, spruce has displaced poplar to a very significant degree. Pallet producers with an integrated operation (sawmill plus pallet plant) are using spruce purchased from outside sources rather than in-house poplar lumber because of the present, (1982) price differential. In Alberta and Manitoba, the leading producing regions of poplar pallets, pallet manufacturers report that the current delivered cost of economy grade spruce ranges from $40 to $45 per cum and the cost of producing poplar approximates $60 per cum. B.C. producers traditionally use utility grade coniferous species.

The foregoing brief analysis shows clearly that poplar lumber production would undoubtedly prove unecomonic in any part of B.C. or Alberta if the construction and/or industrial utility markets constituted a major portion of total sales. A reasonable assumption would be that poplar lumber production would only be feasible if sales of high quality lumber constituted the major sales volume. The sharp increase in mill return to be realized from sales of high grade components intended for the industrial market is illustrated by the market prices shown in Table 18.

TABLE 18 POPLAR LUMBER PRICE LIST, OCTOBER, 1982

($ per cum)

Thickness (cm)	Grade				
	FAS	S&S	#1C	#2A	#2B
2.54	196	191	123	74	67
3.18	200	196	126	75	70
3.81	205	200	130	77	70
5.08	212	207	135	79	70
6.35	233	228	152	110	77

Source: Hardwood Market Report, Lumber News Letter, U.S.

A description of each grade is contained in Appendix 2 but, as is apparent, FAS constitutes the highest grade and #2B the lowest. Although producing the two highest value grades may be difficult and the proportions available from each log may be quite low, the sales return for these grades are obviously high enough to absorb considerable extra cost.

The foregoing selling price discussion, combined with opinions and statements obtained during field interviews, indicate fairly conclusively that successful operation of a poplar sawmill will depend almost entirely on the grade of lumber recovered. In other words, the problem to be resolved is not so much a marketing as a technical production problem. To date, the design and operation of most poplar sawmills have been based on the requirements for producing softwood lumber and the performance record of these plants shows clearly that this approach to processing poplar is economically unsound. The conclusion that a new method of processing poplar into lumber must be adopted, if the operation is to be successful, appears inevitable. Additionally, economic disposal of residue material would be essential.

Trade Inhibitors

Except for some of the developing countries, international trade in lumber is virtually unobstructed by duty or quota barriers. For example, in North America and western Europe, no significant trade barriers exist, but most of the developing nations have imposed complete bans or excessively high tariff rates on imported lumber.

To protect the domestic sawmill industry, Japan imposes a 10% duty on all SPF lumber 16cm and thinner but does not impose duty on any other softwood species nor on hardwoods, including poplar.

Neither Singapore nor Hong Kong apply duties or quotas on lumber of any species, but duty on all hardwood lumber other than squared or partially squared logs into Korea amounts to 20%. A 10% tariff is levied on lumber imported into Taiwan again excepting large cants or logs which are duty-free.

Obviously, tariffs and other artificial trade barriers would have very little, if any, impact or influence on the marketing of poplar lumber into any of the major market regions.

Product Modifications

Suggestions generated during the field interviews related almost entirely to the technical and economic aspects of poplar lumber production and distribution, rather than to improvements or modifications to poplar lumber. In view of the intensely competitive nature of the construction market and of the well-entrenched position of softwoods in that market, capturing a significant, consistent market share for western produced poplar lumber appears to be a difficult task. For a species with the natural characteristics of most poplars, processing logs into material acceptable to the furniture and cabinet industries appears much more promising. One or two smaller producers in northern Ontario and Quebec, through proximity to the substantial furniture industry located in central Canada, have developed reasonably successful techniques for producing components acceptable to the furniture industry. The most serious problem lumber producers attempting to service the furniture industry must resolve is the tremendous range of sizes required by the industry. There are literally thousands of sizes and thicknesses, most of which are required in minor and varying quantities.

One solution to this problem has been proposed and developed to pilot plant stage by the Northeast Forest Experiment Station, U.S. Forest Service. In summary, the method proposes the manufacture of standard sized "blanks" from which furniture/cabinet producers can easily and economically produce exact-sized components. The sizes and thicknesses of the standard "blanks" have been based on an in-depth analysis* of the range of sizes required by the furniture industry. A method** for producing the standard-sized blanks economically from low-grade hardwoods has also been developed and should be seriously considered as a system for processing western Canadian poplar. Although the lumber recovery factor is much higher than in standard sawmill processing, efficient residue utilization would still be an essential requirement for successful operation of the plant.

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*"Meeting the Solid Wood Needs of The Furniture and Cabinet Industries: Standard - Size Hardwood Blanks". U.S. Forest Service, 1981.

**"New Technology for Low-Grade Hardwood Utilization: System 6". U.S. Forest Service, 1982.

A summary of the system developed for processing low-grade hardwood into furniture "blanks" economically is presented in Appendix 3, together with a listing of some of the sizes required by the furniture industry. Commercial experience and research programs in the production of poplar lumber have demonstrated clearly that established, standard processing techniques are not compatible with poplar's natural characteristics and result in uneconomic projects. For this reason, serious consideration should be given to investigating the feasibility of applying the system described in Appendix 3 or to developing a modified version which could process poplar profitably.

Future Demand

Projections of world demand for softwood and hardwood lumber, as developed by two recognized world research agencies, are shown in Table 19.

TABLE 19

PROJECTED WORLD DEMAND, SOFTWOOD AND HARDWOOD LUMBER

(million cum)

Species	Actual		Forecast			
	1980		1990		2000	
	FAO	SRI	FAO	SRI	FAO	SRI
Softwood	318	318	369	341	399	386
Hardwood	103	103	124	120	143	135

Source: "World Forest Products, Demand and Supply, 1990 & 2000", FAO, 1982
"Forest Products Planning Service", Stanford Research Institute, 1982.

Note: SRI's actual projections were to 1995 only. Adjusted to 2000 by CHI on the basis that the average annual increase from 1990 to 1995 will extend to 2000.

FAO's projections to 2000 are more optimistic than SRI's and for the period 1980 to 2000 reflect an average annual growth rate of 1.14% and 1.65% for softwood and hardwood lumber respectively. This compares with SRI's rates of 1% and 1.35% for softwood and hardwood respectively. These rates are consistent with recent world lumber consumption trends and are considered reasonable estimates.

Identification of the regions which are expected to become increasingly dependent on imported lumber is of primary concern to this market analysis and the major deficit areas as defined by FAO are shown in Table 20.

TABLE 20

FORECAST LUMBER IMPORT DEMAND, MAJOR WORLD MARKETS

(million cum)

Region	Species	1980	1990	2000
U.S.	Softwood	15.6	21.5	21.5
	Hardwood	B.	0.1	0.1
Europe	Softwood	4.9	6.3	7.8
	Hardwood	3.1	4.1	4.4
Japan	Softwood	2.8	3.5	4.1
	Hardwood	0.4	0.9	1.0

Source: "World Forest Products, Supply & Demand 1980 to 2000", FAO, 1982.

Note: "B" indicates in balance, i.e., imports plus production less exports equals consumption.

Supply/demand forecasts developed by other agencies indicate trends similar to those shown in Table 20. For example, the Japanese Ministry of Agriculture, Forestry and Fisheries produced long-range forecasts in 1980 which showed Japan's dependency on imported timber declining from 63% to 57% of total consumption in the period 1976 to 1996, but increasing in absolute value from 66.2 to 75.5 million cum(roundwood equivalent) over the same period. A major portion of this increase is expected to be in the form of lumber.

U.S. Forest Service projections* indicate that imports of softwood lumber, which averaged 22% (19 million cum) of total softwood lumber consumption during the 1970's, will amount to 29% (32 million cum) of total usage by 2000. Similarly, hardwood lumber imports are expected to increase to 1.4 from 0.8 million cum in the same period.

All agencies expect the supply (surplus) areas for softwood lumber to be Canada, Latin America, the U.S.S.R. and New Zealand/Australia. Of these, Canada is expected to remain the major surplus area.

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*"An Analysis of the Timber Situation in the U.S., 1953, 2030", U.S. Department of Agriculture, Forest Service.

For hardwoods, only Latin America and Southeast Asia are forecast to be areas with significant excess supply, although the rate of consumption in Southeast Asia is accelerating faster than any of the industrialized regions - 3.7% and 2.6% per annum respectively for softwood and hardwood lumber, as compared to approximately 1.0% for both in the major industrialized areas. Both Canada and the U.S. are expected to remain net importers of hardwood lumber

The obvious conclusion is that a market for substantial volumes of western poplar lumber could be developed if acceptable quality, adequacy of supply and competitive price could all be achieved. As noted previously, these are all technical and economic rather than marketing considerations.

Conclusions and Recommendations

Primarily because of the impact of structural grade panel products, the rate of increase in world lumber consumption has declined from 2.6% to 0.6% per annum between 1950/60 and 1970/80 respectively. The latter modest rate of increase nevertheless amounts, in absolute terms, to the output of approximately 15 international scale sawmills per annum. Hardwood lumber has been less affected than softwood by competing products but still accounts for only one-third of all lumber consumed.

The industrialized regions - North America, western Europe, and Japan - account for the major consumption of lumber of all species but some of the developing countries, primarily Southeast Asian, are experiencing exceptionally high rates of consumption increases and are accounting for growing proportions of all lumber usage.

Consumption of poplar lumber has remained at a relatively minor level in all regions including Canada and the U.S. It is apparent that the low-level of market acceptance achieved in Canada is a direct result of excess volumes of readily available softwood lumber, the perceived undesirable characteristics of poplar (low strength, discoloration) and, in western Canada, the lack of a stable supply.

Because of the highly competitive and volatile nature of the construction market - the principal market for all softwood lumber - the industrial market appears to offer the best potential for western Canadian poplar. However, the major industrial markets are located in eastern Canada or in the U.S., and western producers must be able to absorb relatively high transportation costs. This ability depends on the mill value of the lumber sold and this, of course, depends on the proportion of high-grade material produced. An additional requirement for successful operation of a poplar sawmill would be economical disposal of residue developed.

It is clear that, until adequate volumes of poplar lumber are available on a consistent basis in western Canada, development of overseas markets will not be possible. There are no incentives for overseas buyers (or any other buyers) to purchase poplar lumber produced in western Canada. Except for intermittent periods, all markets are adequately supplied with either softwood or well-established hardwood species. Gaining wide-spread acceptance of poplar would require substantial expenditures of time and money, and potential buyers perceive no reason to undertake the task. Furthermore, existing western Canadian lumber producers are not likely to begin to produce poplar lumber in significant volumes as long as the softwood timber resource remains adequate. In summary, production of poplar lumber is not likely to become a significant part of the western Canadian forest products industry within the foreseeable future if the private sector is expected to undertake the necessary development work. Private industry will participate only if softwood species become scarce and costly or if optional methods for processing poplar lumber can be proven to be profitable. There appears to be little doubt that an operating, economically viable pilot plant of some type will be required before the private sector would make any meaningful investment committment regarding poplar lumber manufacture. Further, without public sector support or initiative, there appears little likelihood that the private sector will commit funds or personnel to the development of efficient poplar processing techniques. For these reasons, it is suggested that government agencies initiate a thorough investigation of new methods for producing poplar lumber. The system described in Appendix 3 could be included in the investigation and could at least provide the basis for further discussion.

In summary, marketing western Canadian poplar lumber is almost entirely dependent on resolving technical and economic problems and not on the size or location of markets.

PLYWOOD AND PANEL PRODUCTS

Introduction

The list of panel products contained in the terms of reference embraces a group of panels and veneers which often compete with and replace one another in certain applications, although made by differing methods for widely divergent uses.

Panels may be separated into two broad classes:

a) Structural Class: This class refers to panels where strength and performance under severe conditions, such as long-term exposure to weather, are the over-riding characteristics. Appearance is not a paramount consideration. These requirements limit, to some degree, the species employed and, generally, require a fully waterproof or "exterior" quality adhesive such as phenol-formaldehyde*. The term exterior is frequently employed to describe this class of panel. In Canada panels classified as structural are generally, Construction Plywood, which includes the coniferous plywoods Douglas-fir, Canadian Softwood Plywood (CSP) and Poplar Plywood, together with waferboard and oriented strand board (OSB). Markets for these are usually in the construction, crating, farm, maintenance and repair sectors of industry. While some of the poplar plywood is made with a non-exterior adhesive it is included in Construction Plywood by Statistics Canada. The terms "construction", "exterior" and "structural" are used interchangeably in the Industry to refer to panels suitable for use under the conditions noted above. The definitions of individual panels may be found on the next page.

b) Non-Structural Class: Panels in this class are usually manufactured for applications where there is no long-term exposure to weather and humidity and the strength properties are not critical. Appearance and surface quality are often of major importance, either in the basic panel or in the final stage after further finishing has been applied. The panels are usually produced with a "non-waterproof" adhesive such as urea-formaldehyde. Typical applications include cabinet and furniture manufacture, sub-strates for prefinishing, wall panelling and miscellaneous millwork. The class includes particleboard (including "thinboard"), hardboard, softboard (insulating boards, acoustic tiles, etc.), hardwood plywood and medium-density fibreboard (MDF) which are defined below.

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*This is true for Canada but, in certain countries, adhesives of lower water-resistant qualities are employed.

Notwithstanding the previous classification, there is considerable overlap in the actual use of all panels. Frequently, a structural panel, for example, construction plywood, will be used in a non-structural application such as furniture components, shelving, etc. based on price and availability. Waferboard may be used as an interior, decorative wall panel. Similarly, the use of non-structural panels merges with the structural. Examples of this are particleboard used as a sub-flooring element in house construction; hardboard employed as exterior siding; and softboard (rigid insulating board segment) used as a wall sheathing. These overlaps in end-uses are considered in detail in the following sections of the report.

Poplar species may be used, technically, in the production of nearly all of the above mentioned panels, but have been most successful as the raw material for waferboard. The physical properties of the species, e.g., density and the generally low volumetric recovery when processing logs, have limited the use of poplar in most panels. The panels within the classes will be discussed in detail from the aspect of production and markets in Canada, U.S., Europe (EEC) and selected countries in Asia.

Definitions and Product Characteristics

Structural Class

a) Waferboard

Waferboard is a sheet material made from wafers resembling small pieces of veneer about 35 to 75mm along the grain, with an average of 0.5mm to 1.0mm in thickness and widths up to about 30mm. Waferboard is a type of particleboard since the wafers are a type of wood particle pressed into a panel by a technology similar to particleboard. However, it is a distinct product in both properties and uses.

In Canada the wafers are cut from roundwood bolts, generally of a poplar species, by specialized waferizing machines. Slabwood could be used also. The cutting action is similar to that of a veneer slicer. Dried wafers are blended with a phenol-formaldehyde resin and formed into a mat which is hot-pressed to a density of about 670 kg/cum. As noted later, mixed hardwoods are becoming important sources of log supply in the U.S. waferboard industry.

The finished panel is "waterproof" and usable in exterior applications due to the waterproof glue employed in the manufacturing. Major uses are for roof and wall sheathings and general utility purposes, in direct competition with structural grade plywood.

The major difference between particleboard and waferboard lies in the size and geometry of the basic wood fibre furnish and in the type of adhesive used. Most particleboard is produced for interior use only, with urea-formaldehyde as the binding agent.

CSA Standard 0188.2 M 78 applies to waferboard produced in Canada.

b) Oriented Strand Board (OSB)

Oriented strand board refers to a waferboard type of panel composed of long narrow wafers which have been processed to produce "strands" with a length to width ratio of 2 or more. These strands can be aligned, more or less in parallel, to improve the strength properties of the panel. Strength and stiffness properties are increased in the "long" direction to a level close to that of coniferous plywood and superior to that of waferboard. Pressing and adhesive characteristics are similar to waferboard. As shown later, some Canadian mills have the capacity to produce OSB.

c) Comply

A veneer can be applied to the face and back of a strand board core to produce a multi-ply structural panel called "Comply". The same type of panel can be made with a particleboard type (non-aligned particles) of core, with phenol-formaldehyde adhesive.

There is no production of Comply in Canada.

d) Construction Plywood

Because it is of major importance in the domestic and export markets and also because it affects the market for waferboard, construction plywood is described in this section. The interplay between the two panels requires them to be evaluated jointly.

Plywood is a panel made of cross-banded layers or plies of veneer bonded with an adhesive. Generally the grain of one or more plies is at right angles to that of the adjacent and almost always an odd number of plies are used. (Veneer bonded to a core of solid lumber or particleboard is also referred to as plywood, although this is normally a non-structural panel used in cabinet manufacture.)

The term "Construction Plywood" is employed by Statistics Canada to include both coniferous plywood and all types of poplar plywood.

Three types of plywood are included in the "Construction" classification:

i) Douglas-fir plywood, in which all the veneers are of coniferous species, with the face and back veneers being specifically of Douglas-fir. The adhesive employed must be of exterior quality and is normally phenol-formaldehyde.

ii) Canadian softwood plywood (CSP), which permits combinations of coniferous and deciduous (poplar only) veneers. The face and back must be of coniferous species other than Douglas-fir. These veneers are generally spruce, balsam or hemlock, with spruce pre-dominating. Two poplar species, p. balsamifera and p. tremuloides, are permitted to be used with coniferous species under the CSA standard for CSP plywood. Adhesive requirements for SCP are the same as for Douglas fir.

iii) Poplar plywood, which may be produced with all veneers of the poplar species of interest to this study or with only the face and back veneers of poplar. Inner plies may be of birch or any combination of several coniferous species, spruce being the most commonly used. Black cottonwood (P. trichocarpa) is not permitted in any construction grades.

Poplar plywood is made with either exterior or non-exterior adhesives. When used in structural applications it must conform to the same adhesive requirement as the coniferous plywoods.

Construction plywood may be further sub-divided into two broad grade groups - sanded or sheathing. Sanded plywood is made with a face of the highest quality, smooth cut veneer, which is sanded to prescribed tolerances, permitting high quality final surface treatments, e.g., painting, overlaying. Sheathing plywood permits a generally knotty, rough veneer face, with certain open defects and is, for the most part, not sanded. There are, however, select sheathing grades which are given a degree of sanding, to tolerances broader than those specified for sanded grades.

Generally, but not exclusively, waferboard and sheathing grades of plywood are in direct competition with one another.

For purely structural uses, such as concrete forms, roof and wall sheathing, etc., plywood made from softwood species is the generally accepted type in Canada. Thicknesses range from 6.35mm to 25.4mm while panel dimensions are normally 1220mm x 2440mm.

e) Veneer

Veneer, generally, is the product of a peeling action in which a log is rotated about its horizontal axis in a lathe against a specialized fixed knife running the length of the log. The wood material comes off in thin sheets ranging from 2.54mm to 6.35mm thick, as desired.

CSA Standards 0121-M, "Douglas Fir Plywood"; 0151-M, "Canadian Softwood Plywood"; 0153-M "Poplar Plywood" regulate production in Canada.

Non-Structural Class

The non-structural panel group, comprising particleboards, fibreboards, and hardwood plywood (poplar), is complex because of the many overlaps in the use of the products. Some of these panels, generally made with a non-waterproof adhesive, often compete with the fully exterior type of panels.

a) Particleboard

Particleboard means a panel generally made for non-structural uses and which is usually, although not always, bonded with a non-exterior adhesive, urea-formaldehyde. With one or two exceptions, the appearance of the panel is that of a relatively fine material as opposed to the characteristically flat wafers found in waferboard. From a technical aspect, both panels are in the same family.

In Canada, particleboard is manufactured from wood material in the form of particles produced by mechanical means such as chipping, flaking, hammermilling, etc. as distinct from fibres which are made by refining by steam and high pressure. The raw material may be from roundwood or from by-products of other processes, e.g., shavings which are subsequently broken down into a random mixture of various shapes and sizes, but all of which are elongated compared to their thickness.

Most particleboard is made in a thickness range of 12.7 mm - 25.4 mm with a density range of 640 kg - 720 kg per cum. Some is made at 300 kg per cum for door cores. Recently, the introduction of press systems designed to make panels economically in the 6.35 mm thickness and lower range has brought about the term "thinboard". This class of particleboard is similar to the standard panel in all respects except the average thickness range and, usually, higher densities.

Thinboard may be made in a horizontally oriented, flat, single opening press up to 8' x 50' in dimensions or by a large diameter drum press up to 8' in length, in which the mat follows the circumference, passing under several auxiliary pressure rolls. Heat is applied in both systems. Canadian Standard 0188.1-M "Mat Formed Particleboard" applies to the manufacture of particleboard in Canada.

b) Fibreboard

The description "fibreboard" describes panels manufactured primarily from interfelted lignocellulosic fibres (usually wood) made by either pressure refining or grinding and then consolidated under heat and pressure in a press. The pressing may be either by a "wet" process in which the fibres are carried in an aqueous suspension and pressed in the wet condition or "dry" process in which the fibres are dried before pressing. The greatest part of the bond in the wet process results from the interfelting of the fibres. All production in Canada is by the wet process method.

Three types of fibreboards are recognized, generally classified by density range:

i) Hardboard:

Hardboard is fibreboard, generally from 6.25mm up to 11.1mm thick, produced to a density greater than 496 kg/cum, up to 990 kg, in a wet process. It is described also as "compressed fibreboard" in international publications. A minimal amount of phenolic resin is added before pressing. The wet process requires a screen installed on the press plate to permit escape of steam. The screen imparts a pattern to the fibre mat so that the lower side of every panel is "screen backed". This rough appearance limits the usefulness of the panel, since only the smooth face side can be exposed in applications where surface quality is important, e.g., prefinished paneling.

ii) Softboard:

Softboard is a fibreboard made in a wet process and pressed to densities less than 496 kg/cum. It is also called "rigid insulating board" in North America and "non-compressed fibreboard" internationally. This is sometimes impregnated with asphalt for wall sheathing uses. Ceiling (or acoustic) tiles are becoming the major products of the softboard group. Generally, starch is used as a binder in these. Most softboards are about 12mm thick.

iii) Medium-Density Fibreboard (MDF):

MDF is made by the dry process with the addition of about 10% of urea-formaldehyde resin and compressed to a density range of 720 - 880 kg per cum. Most MDF panels are in the 15.8mm to 19mm thickness range. The panel is typically smooth and even-textured, with excellent edge and machining properties, and may be used either as a core panel or as a substrate for direct printing and finishing. A key element in the production process is the use of a pressurized steam refining system to produce the "slurry" which is then flash-dried prior to blending and pressing. There is no production of MDF in Canada.

Quality standards for fibreboards are regulated by the Canadian General Standards Board (CGSB), which administers standards for Federal Government purchases.

c) Hardwood Plywood

The other broad class of plywood made in Canada, distinct from the construction class, is generally referred to as hardwood plywood. While, technically, poplar is a hardwood, for statistical purposes it is included in the "Construction Plywood" class by Statistics Canada. The building and plywood industries use the term hardwood plywood to include panels made with various native veneer faces such as birch, maple, elm, ash and foreign species such as rosewood, teak, lauan, meranti, mahogany, walnut, etc. Most of the latter types of plywood are imported in panel form, although some veneer is imported and applied to cores such as particleboard, in Canada. These panels may be overlaid with films or prefinished with lacquers, printed papers in Canada and are also categorized in the hardwood class although they are not strictly plywoods. Other than providing a market for a small volume of poplar plywood and for a much larger volume of reconstituted panels used as substrates in the prefinishing sector, hardwood plywood is not of major significance in the context of this study. CSA Standard 0115 "Hardwood Plywood" refers to the production of hardwood plywood in Canada.

World Capacity for Panels - Development and Trends

While Canada and the U.S. tend to consider only panels made with "exterior" adhesive to be "structural", such is not the case in most other markets. Foreign construction practices frequently permit the use of panels such as particleboard and non-waterproof plywood in applications for which North American authorities require exterior panels. For this reason the structural and non-structural panel market opportunity must be viewed in the light of all types of wood-based panels.

In Tables 80, 81 and 82 of Appendix 4, general estimates made by FAO for the production and consumption of all types of wood based panels for 1970, 1975 and 1980 are shown. The production of the major panels which relate to the potential development of the western Canadian poplar panel industry is summarized in Table 21.

Since 1960, plywood production has increased at an annual rate of about 5%, particleboard at a rate of about 13% and fibreboad at less than a 3% rate. Figure 7 illustrates clearly the rise of particleboard to a leading position.

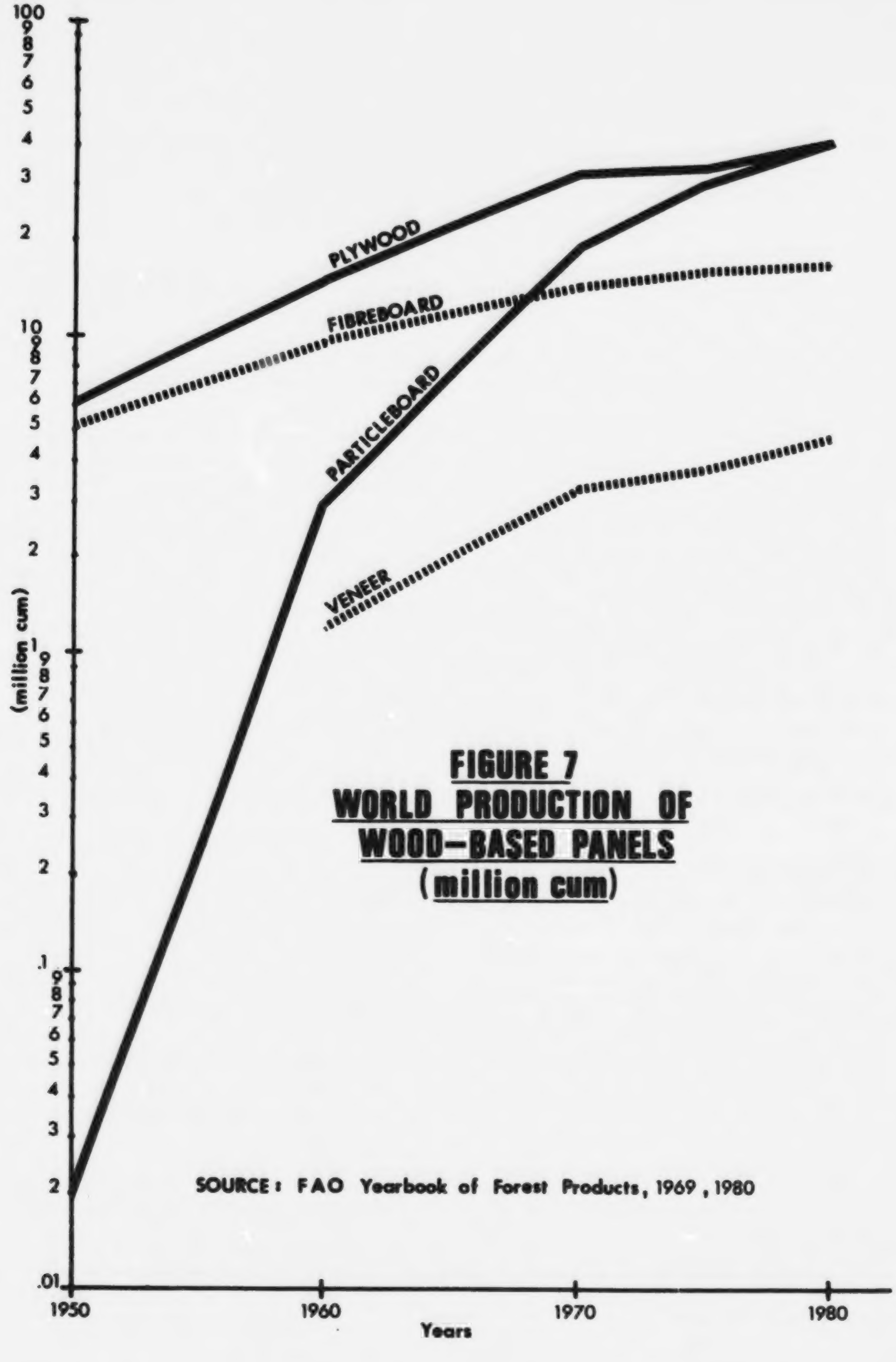

FIGURE 7
WORLD PRODUCTION OF
WOOD–BASED PANELS
(million cum)

SOURCE: FAO Yearbook of Forest Products, 1969, 1980

TABLE 21 WORLD PRODUCTION OF WOOD-BASED PANELS

(million cum)

Product	1950	1960	1970	1975	1979	1980
Veneer	-	1.20	3.30	3.80	4.70	4.80
Plywood	6.10	15.30	33.20	34.30	43.20	40.30
Particleboard	0.02	3.10	19.20	30.60	41.00	40.30
Fibreboard	5.40	9.50	14.20	15.90	18.00	16.50
Total	11.52	29.10	69.90	84.60	106.90	101.90

Source: FAO Yearbook of Forest Products, 1960, 1979, 1980.

Note: Plywood includes blockboard, particleboard includes waferboard and fibreboard includes medium-density fibreboard (MDF).

There are significant differences in the world output of panels on a regional basis and these are of great importance in developing markets for panels made in Canada. Panel production capacity of the major regions is as follows.

TABLE 22 REGIONAL PRODUCTION OF WOOD-BASED PANELS

(million cum)

Region	1950	1960	1970	1975	1979	1980**
North America*	7.4	14.8	26.3	28.7	37.2	32.5
Europe	2.6	8.8	22.0	28.6	34.7	34.0
Japan	0.2	1.6	8.5	7.6	10.2	10.2
U.S.S.R.	0.7	2.0	6.0	9.2	10.3	10.2
Asia (Less Japan)	0.1	0.8	3.3	5.7	8.8	8.4
Latin America	0.2	0.5	2.1	2.8	3.4	4.2
Africa	0.1	0.3	0.8	1.0	1.1	1.2
Oceania	0.1	0.4	0.8	0.9	1.1	1.2
World Total	11.4	29.2	69.8	84.5	106.8	101.9

Source: FAO, Yearbook of Forest Products, 1960, 1979, 1980.

Note: Numbers do not always add due to rounding.

*Canada and U.S.
**FAO estimates.

In 1950, North America accounted for 64% of total world production but accounted for only 32% in 1980. Japan and the remainder of Asia have developed rapidly to account for approximately 18% of the total production in 1980 compared to 3% in 1950. However, production in Japan is expected to stabilize, if not decline, while the forests in the Philippines, Indonesia and Malaysia are approaching maximum yield which will affect all of the Southeast Asian panel industries adversely.

Production of panel products will continue to grow, especially the reconstituted panels, particleboards and fibreboards. This is important to Alberta and B.C. since poplar has been proven to be technically suitable for the manufacture of any of the reconstituted wood panels, but is less suitable, economically, for the production of lumber or plywood.

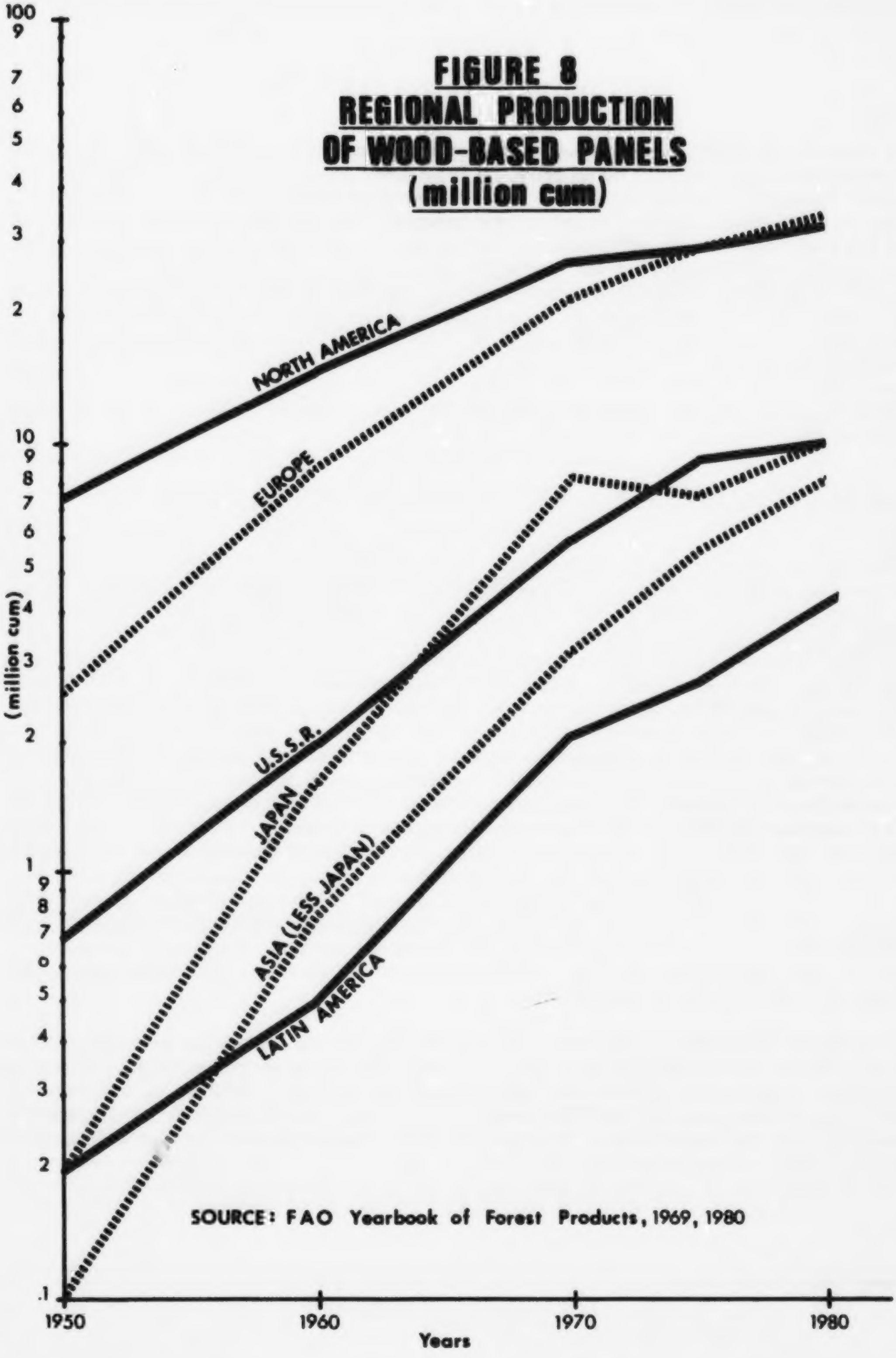

FIGURE 8
REGIONAL PRODUCTION OF WOOD-BASED PANELS
(million cum)

SOURCE: FAO Yearbook of Forest Products, 1969, 1980

When Appendix 4, Tables 80, 81 and 82 are examined, certain regions are seen to be more than adequately supplied with panel products from their own resources. For example, the European Economic Community (EEC), with its immense production of particleboard (13 million cum in 1980), appears to be a poor prospect for any reconstituted wood-based panel from western Canada with, perhaps, the exception of MDF. Europe, in total, offers a poor export market prospect for Canadian particleboard and fibreboards. There is an extensive trade within the EEC, and between EEC members and other European countries in all types of panels. Within the global picture, however, there may be opportunities for MDF in certain countries of Europe and Asia. This possibility is developed in subsequent sections of this report.

Within the above regions significant changes in panel markets have occurred as highlighted below.

TABLE 23 EEC, PRODUCTION, SHIPMENTS OF WOOD-BASED PANELS

(thousand cum)

	1970				1980			
	Prod'n	Imports	Exports	Cons	Prod'n	Imports	Exports	Cons
Plywood	1,890	1,771	338	3,323	1,588	2,634	612	3,610
Particleboard	7,902	1,414	1,184	8,132	13,135	3,963	2,359	14,739
Fibreboard	1,131	1,261	299	2,093	969	1,081	286	1,764
Total	10,923	4,446	1,821	13,548	15,692	7,678	3,257	20,113

The trend in plywood production, which includes structural and non-structural panels of both coniferous and non-coniferous species, indicates a gradual take-over of the plywood market by the other panels. Whereas plywood consumption has increased by a modest 9% over the ten year period, particleboard exhibits a sharp increase of 81%. Both in the rate of increase and increase in total market share, particleboard dominates the EEC panel industries. Of particular interest to Canada is the increase in imports of plywood and particleboard which have increased by 250% and almost 900% respectively. Almost 66% of the plywood is North American softwood, whereas the particleboard comes mainly from the EFTA* countries, the U.S.S.R. and central European nations. Fibreboard production, which is mainly hardboard in Europe, continues to decline. However, as will be shown, the MDF sector shows a positive growth trend.

As indicated in Table 24 plywood production and consumption both show positive growth rates of considerable magnitude in Asia but, since 1980, some countries, e.g., Japan and Korea have experienced substantial reductions. Particleboard exhibits a very strong upward trend of the order of a 300% increase in the ten year period. Asian fibreboard consumption has increased and it is apparent that production is essentially consumed within the region. (See Appendix 4, Tables 80, 81 and 82.)

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*European Free Trade Area.

TABLE 24 ASIA, PRODUCTION, SHIPMENTS OF WOOD-BASED PANELS*

(thousand cum)

Selected Years

	1970				1980			
	Prod'n	Imports	Exports	Cons	Prod'n	Imports	Exports	Cons
Plywood	10,063	457	2,342	8,178	14,258	1,182	3,983	11,457
Particleboard	597	27	15	609	1,726	210	49	1,887
Fibreboard	1,076	63	13	1,126	1,289	98	24	1,363
Total	11,736	547	2,370	9,913	17,273	1,490	4,056	14,707

*Includes India, Taiwan, Peoples' Republic of China and Japan

Product Selection

There is a wide choice of panel products which can be made from the three poplar species of importance to this study. Each product offers different opportunities in utilizing the species from technical and economic viewpoints. It is self-evident, from a review of the extensive body of literature on poplar plywood and lumber production, that the growth characteristics, the incidence of decay, the low density of the species present formidable challenges to a producer. Nevertheless, most poplar products are of good quality. However, the costs of production of lumber and plywood are often excessively high. In general, the reconstituted panels can be produced from lower quality material and, therefore, offer greater chances of success in highly competitive markets.

The major panel products which can be made from poplar, with varying expectations of success, are waferboard, OSB, Comply, particleboard, MDF, hardboard, softboards and plywood. All are considered in this report.

WAFERBOARD AND OTHER STRUCTURAL PANELS

Regional Markets

Canada

Waferboard, in a period of 15 years, has become a major element in the Canadian structural panel industry as shown in Table 25. In 1970, coniferous plywood capacity represented 91% of the Canadian panel total of 2.3 million cum, with waferboard representing only 3%, but these values will be about 65% and 32%, respectively, in 1983. However, there are indications that further permanent plywood plant closures may occur which would reduce the total capacity for plywood. In addition, several waferboard mills have undergone extensive curtailments during the past 18 months. However, a return to the 1980 level of production is indicated by first quarter statistics for 1983.

TABLE 25

CANADA
ESTIMATED CAPACITY FOR STRUCTURAL PANELS

(thousand cum)

	Coniferous* Plywood	Poplar** Plywood	Waferboard	Total
1960	1,050	100	-	1,150
1961	1,200	100	-	1,300
1962	1,360	110	n/a	1,470
1963	1,480	120	n/a	1,600
1964	1,690	130	65	1,885
1965	1,740	130	65	1,935
1966	1,830	130	65	2,025
1967	1,920	140	65	2,125
1968	2,050	140	65	2,255
1969	2,100	140	65	2,305
1970	2,100	140	65	2,305
1971	2,100	150	120	2,370
1972	2,200	150	120	2,470
1973	2,530	150	200	2,880
1974	2,530	150	390	3,070
1975	2,500	150	450	3,100
1976	2,800	140	450	3,390
1977	2,800	140	470	3,410
1978	2,800	140	470	3,410
1979	2,800	120	620	3,540
1980	2,700	120	800	3,620
1981	2,650	120	950	3,720
1982	2,650	110	1,160	3,920
1983	2,560	100	1,280	3,940

Source: CHI file data, interviews.

*Includes Douglas-fir and CSP.

**Poplar includes both interior and exterior types. Both are counted as "construction".

The peak of domestic consumption of construction plywood occurred in 1978 at 2.2 million cum. Since then a decline is evident. Consumption for 1982, 1.4 million cum, of which only about 30,000 cum was exterior grade poplar.

While coniferous plywood exports account for a large share of total shipments, this aspect will not be of major significance in this report, although coniferous plywood is a factor in restricting waferboard shipments to the EEC through the provision for a duty-free quota for coniferous plywood.

It is estimated that 1.3 million cum or 75% of the total softwood plywood, i.e., Douglas-fir and CSP combined, consumed domestically in 1981 was in a sheathing grade. This is the grade of panel with which waferboard competes most directly. In addition, waferboard must compete with imported plywood.

Softwood plywood imported from the U.S. rose to a peak of 452,000 cum (23% of consumption) in 1975, when the U.S. market was weak and a large surplus became available for export to Canada from the Pacific Northwest. However, the volume of plywood imported from the U.S. declined to about 15,000 cum in 1982, largely due to the availability of Canadian waferboard.

In evaluating markets for structural panels, it is necessary also to give consideration to portions of the non-structural panel output, since some of these compete directly with construction plywood and waferboard, especially in the sheathing grades in Canada. There is no clear line of distinction between many end-uses, for example: siding may be plywood or hardboard, underlayment may be coniferous or poplar plywood or particleboard. Conversely, there are uses such as shelving, millwork, counter-tops, etc. where coniferous plywood may be used in place of particleboards. An analysis of these uses would require an intensive survey.

The most important of the non-structural group in the above sense is rigid insulating board, a non-compressed fibreboard (softboard). Of the insulating board panels which affect markets for exterior structural panels, the plain or coated boards and the asphalted sheathing boards are important.

A small volume of particleboard is produced in both Canada and the United States with a phenolic adhesive and, in addition, a substantial volume, estimated at 8 -10% of Canadian consumption, is bonded with urea-formaldehyde but is marketed as sub-flooring and underlayment panels for both regular and mobile home construction. For these uses, some of the particleboard competes with exterior panels and must be considered in the examination of the waferboard market.

The Canadian waferboard industry, which is the largest consumer of poplar roundwood, began in 1962 with the construction of the mill in Hudson, Bay, Saskatchewan. In the period 1970-1982 ten more mills were built and one other is under construction for completion in the fall of 1983. Estimated capacity at year end 1983 will be 1.28 million cum, of which the three western mills will represent 366,000 cum. Table 26 summarizes the estimated capacity for waferboard to the end of 1983.

The rapid development of this industry, mainly in eastern Canada, resulted from the steadily increasing cost of peelable coniferous logs for the plywood industry in the west. The availability of relatively low cost poplar within a short distance of the major population centers in the eastern provinces, which consume significant volumes of sheathing materials in the home construction industry, stimulated waferboard development east of the Great Lakes.

TABLE 26 CANADA WAFERBOARD MILLS ESTIMATED CAPACITY TO YEAR END 1983

	Annual Capacity (cum)
Great Lakes Forest Products Ltd.	
Thunder Bay, Ontario	105,900
MacMillan Bloedel Limited	
Hudson Bay, Saskatchewan	132,400
Thunder Bay, Ontario	117,700
Waferboard Corporation	
Timmins, Ontario	70,600
Weldwood of Canada	
Longlac, Ontario	110,300
Slave Lake, Alberta	110,300
Northwood Panelboards Limited	
Chatham, N.B.	141,200
*Normick-Perron Ltee	
La Sarre, Quebec	44,100
*Malette Waferboard	
St. Georges de Champlain, Quebec	114,700
*Grant Waferboard	
Englehart, Ontario	114,700
*Forex-Leroy	
Val d'Or, Quebec	97,100
*Pelican Spruce (Start-up 1983)	
Edson, Alberta	123,600
TOTAL	1,279,600

*Mill has capacity for OSB.

OSB has been produced intermittently in the four mills in eastern Canada but the statistical data for this panel are included in that for waferboard. In this report CHI includes the small volume of OSB produced in the discussion of waferboard as if it were the same product.

Waferboard Market

The trend in production and shipments of waferboard, shown in Table 27, is strongly upward from the first year of production in Canada. It should be noted, however, that the 1981 production level represented a capacity utilization of only 73% and that this dropped to 42% in 1982.

TABLE 27

CANADA

WAFERBOARD, PRODUCTION, AND SHIPMENTS

(cum)

	Production	Shipments			
		Domestic	Exports	Total	
				cum	thousand $
1970	57,370	54,721	-	54,721	n/a
1971	97,087	88,261	4,413	92,674	n/a
1972	110,327	97,087	8,826	105,913	n/a
1973	141,218	123,566	15,004	138,570	n/a
1974	216,240	154,457	44,131	198,588	n/a
1975	273,610	141,218	127,979	269,197	n/a
1976	314,299	145,631	138,570	284,201	37,754
1977	361,029	191,697	191,527	383,224	53,865
1978	450,817	227,714	228,597	456,311	72,732
1979	569,285	258,605	269,197	527,802	88,694
1980	545,331	275,361	301,169	576,530	79,909
1981	696,331	368,176	298,023	666,199	103,248
1982	492,447	294,580	241,419	535,919	76,780

Source: Statistics Canada, CHI Files, Interviews.

Note: Prior to 1976 waferboard was not reported as such by Statistics Canada. Data for 1970-1976 are from industry sources.

On average, about 50% of total shipments has been consumed domestically but, as explained later, it is probable that the average volume exported (mainly to the U.S.) will decline, diverting more waferboard to the domestic market where it will exert pressure on the construction plywood industry. Because there are no imports of waferboard, domestic shipments represent apparent consumption.

In comparison to the value of waferboard shipments in 1982, the value of coniferous plywood shipments is estimated at $500,000,000. The value of poplar plywood shipments for the same year is estimated at about $6,000,000.

Table 28 shows the relative position of waferboard relative to the other panels which are used in an essentially structural source in Canada.

Plywood consumption has declined by 10.6% from 1970 - 1982 and apparently now represents only 72.5% of total consumption of these panels, while waferboard has increased to 15.8%. It is the only structural panel exhibiting such a positive trend.

TABLE 28 CANADA

APPARENT CONSUMPTION OF PANELS FOR ALL STRUCTURAL USES

(thousand cum)

	Const. Plywood	%	Wafer-board	%	Particle-board*	%	Rigid Ins. Bd.**	%	Total	%
1970	1,433	81.3	55	3.1	59	3.4	214	12.2	1,761	100
1971	1,596	79.5	88	4.5	69	3.5	251	12.5	2,005	100
1972	1,799	79.5	97	4.3	86	3.8	281	12.4	2,262	100
1973	1,913	78.1	124	5.0	111	4.5	304	12.4	2,451	100
1974	1,917	78.3	154	6.3	101	4.1	275	11.3	2,448	100
1975	2,058	79.7	141	5.5	105	4.0	277	10.8	2,582	100
1976	2,206	79.8	146	5.2	102	3.7	312	11.2	2,766	100
1977	2,109	78.8	192	7.2	94	3.5	281	10.5	2,675	100
1978	2,227	77.7	228	7.9	96	3.4	316	11.0	2,867	100
1979	1,991	75.4	259	9.8	89	3.4	301	11.4	2,639	100
1980	1,942	77.1	275	10.7	66	2.6	236	9.4	2,519	100
1981	1,865	74.1	368	14.6	51	2.0	233	9.3	2,516	100
1982	1,353	72.5	295	15.8	35	1.9	184	9.8	1,867	100

*Estimated volume used in structural applications only (underlayment, etc.).

**Natural, coated and asphalt sheathing panels only.

Source: Statistics Canada, CHI estimates. Imports included. Data rounded.

When the preceding data is presented graphically (Figure 9), waferboard's strong position in the structural panel sector is clearly evident.

The use of hardboard siding is an element in structural panel consumption. No accurate historical data are available, but CHI estimates the volume consumed in 1981 was 94,000 cum. This is not included in the above data but the exclusion does not alter the percentages significantly.

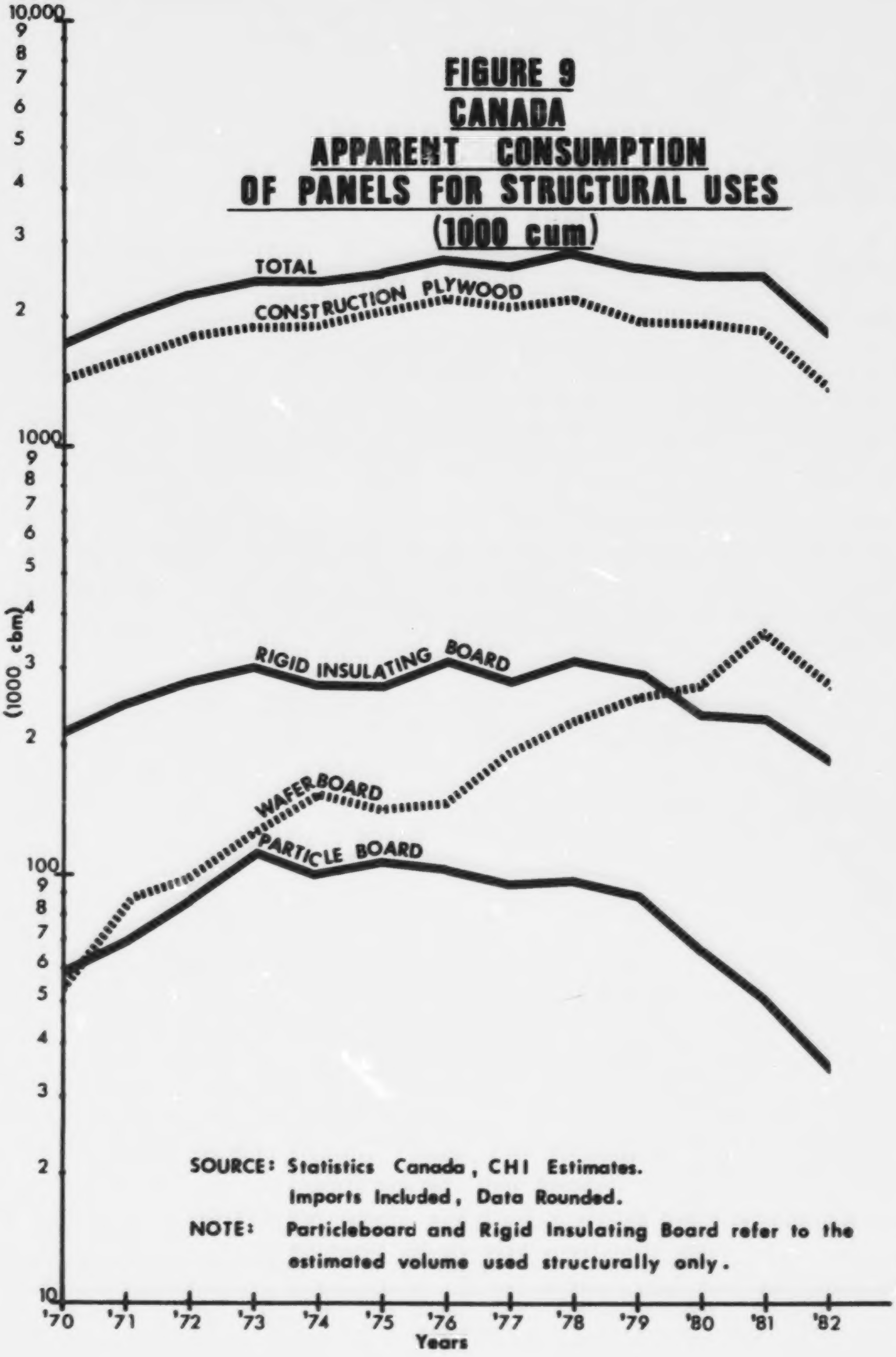

FIGURE 9
CANADA
APPARENT CONSUMPTION OF PANELS FOR STRUCTURAL USES
(1000 cum)

SOURCE: Statistics Canada, CHI Estimates.
Imports Included, Data Rounded.

NOTE: Particleboard and Rigid Insulating Board refer to the estimated volume used structurally only.

An inspection of Statistics Canada reports for 1981 indicates that waferboard represented 39% of all sheathing panels consumed in Ontario and Quebec, an increase of 100% since 1979. Plywood sheathing dropped from 57% to 32% in the same period.

Data are not available for a similar detailed comparison for western Canada but it is probable that construction plywood dominates the regional sheathing market.

End-Use Markets

There are five Canadian market sectors in which waferboard and other structural type panels are consumed. These are the new residential construction, homeowner/renovation, non-residential construction, farm and industrial sectors. Since the supply of panels moves into these sectors from the producing mills by means of either direct, wholesale or retail shipments, an analysis of the markets is a complex problem. There are no reliable nationally reported data so it is necessary to make estimates based on indirect means.

The relative market shares for the major structural panels, have been derived from a study by Bowland* which estimated the volumes of wood products used in all types of wood-framed houses as reported by Canada Mortgage and Housing Corporation (CMHC). The data was up-dated by CHI to produce Table 29 which shows the estimated consumption by panel and major market sector.

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*"The use of wood and wood-based building materials in new residential construction in Canada, 1969" - Bowland, J.G., Canadian Forestry Service, 1972.

TABLE 29

CANADA
ESTIMATED CONSUMPTION OF STRUCTURAL PANELS BY MARKET SECTOR, 1981

(thousand cum)

Sector	Construction Plywood		Waferboard		Particleboard		Rigid Insulating Board		Hardboard Siding		Total	
	%	Vol.	%	Vol.	%	Vol.	%	Vol.	%	Vol.	%	Vol.
New Residential Construction	26	484.9	50	184.1	40	20.2	45	104.9	60	56.4	33	850.5
Homeowner/ Renovation	35	652.7	30	110.4	15	7.5	5	11.7	25	23.5	31	805.8
Sub-Total	61	1,137.6	80	294.5	55	27.7	50	116.6	85	79.9	64	1,656.3
Non-Residential Construction	14	261.0	8	29.5	10	5.1	20	46.6	10	9.4	13	351.6
Farm	6	111.9	8	29.5	-	-	15	35.0	5	4.7	7	181.1
Industrial	19	354.3	4	14.7	35	17.7	15	35.0	-	-	16	421.7
Total	100	1,864.8	100	368.2	100	50.5	100	233.2	100	94.0	100	2,610.7

Source: CHI estimates

A brief description of each of the market sectors, and the use of the structural panels in it, follows. Lumber is still important in all sectors, although not examined here.

New Residential Construction Market

This market sector covers the construction of new wood frame dwellings, generally under three storeys in height, as defined by CMHC. Typical uses of structural panels are:

a) Foundations: Construction plywood and waferboard are the primary panel materials employed for foundations which may be either concrete form panels or preserved wood incorporated into the structure.

b) Wall Sheathing: This is, typically, sheathing grade construction plywood, waferboard, or rigid insulating board applied to the lumber framing and to which the exterior finish is attached. It may sometimes be combined with exterior finish for a "single skin" application. Gyproc sheathing and lumber are competitive in the wall sheathing applications.

c) Roof Sheathing: Roof sheathing is applied to the roof joists and covered with roofing material such as asphalt shingles, etc. The panels employed in this use are sheathing grade construction plywood and waferboard. Lumber is still widely used as roof sheathing in some regions.

d) Exterior Cladding: This may be construction plywood in various grades, or hardboard siding. Lumber and aluminum siding are major competitive elements in this market.

e) Sub-Flooring, Underlayment: This application includes panels used over the floor joists to form the supports of finished floor material and to provide a smooth base for the application of tiles and carpets. Construction plywood, waferboard and particleboard, as well as lumber, may be employed.

f) Fixtures, Cabinets, Shelving, etc.: This group includes most of the detailed finishing items of a dwelling where various combinations of structural and non-structural panels may be used such as construction plywood, waferboard and particleboard. Generally, built-in kitchen cabinets and counter-tops are of industrial particleboard.

g) General Site Work: This refers to the consumption of structural panels for general, temporary site work such as trench lining, sheds, supports, etc. Plywood and waferboard are the important panels for these uses.

The significance of the new residential housing market is readily apparent from Table 29. It represents a market for one third of all structural panels and consumes about 50% of the total Canadian domestic shipments of waferboard.

Homeowner and Renovation Market

The homeowner market consists of "do-it-yourself" (DIY) additions and modifications to existing residential structures; construction or alterations to cottages and vacation homes. The construction of garden sheds, tool sheds, fences, screens, sand boxes, boxes, pet shelters and miscellaneous items is included in this important market which absorbed an estimated 31% of shipments of structural panels, amounting to 805,800 cum, in 1981. About 80% of all waferboard consumption is in this and the new residential construction market segments as shown in Table 29.

Generally, in times of economic constraint such as in the period 1981 - 1982, there is a tendency towards increased DIY alterations and additions to existing residences. Construction plywood has been widely employed for those uses for several years and now waferboard is becoming accepted to a marked degree. In western Canada, this has not been as pronounced as in the east but there are indications of an upward trend in Alberta and B.C. The general utility value of the panel, combined with ease of cutting and nailing and relatively low cost, will continue to stimulate more consumption of waferboard.

Non-Residential Construction Market

Non-residential construction refers to all forms of construction such as highways, bridges schools, high-rise buildings, airports, marine structures, dams, etc. In this group, exterior wood-based panels are generally used both for shoring, concrete forming, utility purposes, etc. and also may be incorporated into the structure to various degrees. Plywood, for which unit stress values are well defined, is far more widely used than waferboard in the major structures. Waferboard is mainly used as a general utility panel for fencing, temporary site structures and related uses although, for certain classes of commercial buildings and low-rise schools, it may be a part of the structure. As indicated in Table 29 an estimated 13% of all structural panel consumption, or 351,600 cum, was employed in non-residential construction in 1981.

Farm Market

The farm market, which absorbed about 176,400 cum of structural panels in 1981, includes all agricultural buildings other than residences. Barns, granaries, feeders, pens, sheds and a host of miscellaneous structures are included in this market sector.

Increases in structural panel consumption are estimated to be very modest. However, it is likely that waferboard will penetrate this market at a rate greater than currently estimated. This may be especially true in the west as added capacity comes into production in Alberta in late 1983.

Industrial Market

The industrial market comprises all uses of panels for pallets, containers, rail and truck bodies, ship components, plant repair and maintenance, jigs, patterns, crating, etc. Mobile homes, travel trailers, recreational vehicles and some furniture are also included in the industrial group. Waferboard does not appear to be of major importance yet, but a strong potential for expansion exists, especially where oversize panels may be required and in construction of floor panels and I-beams.

Future Demand

a) New Residential Construction Market

There have been numerous forecasts by various analysts of the level of housing starts in Canada but, in CHI's judgment, the forecast made in 1981 by CMHC* is probably the best indicator of future demand. Table 30 relates the forecast of housing starts required to the probable consumption of structural panels for two five year periods to 1991.

TABLE 30 PROJECTED MARKET FOR STRUCTURAL PANELS FOR NEW HOUSING

	1981-1986	1986-1991
Average Annual Number of Housing Starts Required	210,000	181,000
Average Annual Consumption of:	(cum)	(cum)
Construction Plywood	490,000	341,000
Waferboard	270,000	380,000
Particleboard	24,000	15,000
Rigid Insulating Board	84,000	38,000
Hardboard	67,000	70,000
TOTAL	935,000	844,000

Factors which affect the pattern of use for the respective panels are fluctuations in the number of single family units, changes in the average size of dwellings and changes in regional demand based on demographic forecasts. Waferboard shows the only significant growth trend, amounting to about 4% annually over the ten year period while hardboard shows a practically level trend. The estimates for the housing sector are combined with the probable consumption for the other major markets in Table 31, which follows.

For each type of panel the probable rate of increase or decrease in non-housing markets has been estimated, based on interviews and CHI's judgement. The rates have been assumed to be valid throughout the period to 1991. The volumes of structural panels required for housing and non-housing consumption have been combined in Table 31.

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*"The Demographic Future: Impacts on the Demand for Housing in Canada, 1981 - 2001". Canada Mortgage and Housing Corporation, 1981. (See Appendix 5)

TABLE 31 CANADA
ESTIMATED AVERAGE ANNUAL CONSUMPTION OF STRUCTURAL PANELS FOR ALL MARKETS

	1981-86		1986-1991	
	% of Total	cum	% of Total	cum
Construction Plywood	71	1,810,000	64	1,630,000
Waferboard	14	357,000	27	700,000
Particleboard	2	50,000	-	-
Rigid Insulating Board	9	226,000	5	120,000
Hardboard	4	91,000	4	90,000
Total	100	2,534,000	100	2,540,000

Summary

Waferboard

Waferboard consumption is affected by the level of new housing starts which will be, by CMHC forecasts, a negative factor over the next 10 years. About 50% of domestic shipments are used in new housing. However, the home renovation sector and continuing erosion of construction plywood markets over the next five years will, increase demand for waferboard. The other uses, such as non-residential construction, farm and industrial should recover and contribute marginally to an expanding market which CHI estimates will increase by 7% annually. Waferboard, including OSB, will continue to increase its share of the structural market.

The position of OSB in the Canadian market is not readily definable. A relatively small volume has been produced to date but with the completion of the new OSB mill at Edson, Alberta, the market could develop rapidly. Marketing factors, transportation and the perceived need for a stronger panel than standard waferboard in a basically sheathing application will determine the outcome.

The annual Canadian domestic waferboard shipments during the next 10 years is expected to be much less than the installed capacity in 1983.

As already noted, in Table 26, capacity at year end 1983 is estimated at 1.28 million cum. This will probably be the situation in 1985, except for possible internal expansion and improvements in some existing mills. Table 27 showed that shipments in 1982 were only 536,000 cum, of which 295,000 cum were for the domestic market and 241,000 cum for exports. Table 31 indicates that the average annual volume consumed domestically will be only 700,000 cum in the period 1986-1991 or about 55% of present (1983) capacity. This leaves a balance of almost 600,000 cum available for exports which would require a 100% increase in the present level. The Canadian Waferboard Association is increasing its general promotional activity in both the U.S. and the EEC, but faces formidable hurdles. Export limitations and opportunities are discussed in ensuing sections. New export markets are vital if surplus poplar in B.C. and Alberta is to be utilized.

Particleboard

The consumption of particleboard, used structurally for underlayment, will continue to decline to minimal levels. Sanded waferboard will penetrate this market and eventually replace the particleboard. There will, in all probability, continue to be some production of phenol-formaldehyde bonded particleboard, but the total volume will not be large. Therefore, it may be concluded that the structural application of particleboard does not, in itself, offer a significant opportunity for utilization of poplar species.

Rigid Insulating Board

The rigid insulating boards used as wall sheathing will probably continue as a factor in structural applications, but the major market will be in Ontario and Quebec, close to the major supply base. The mills already producing insulating boards in Alberta and Manitoba appear to be capable of supplying the western market and, therefore, expansion of facilities or new facilities do not seem necessary.

Hardboard

Hardboard siding will be in demand in Canadian structural markets in all provinces, competing with lumber, plywood and aluminum sidings. The total annual volume of hardboard consumed in structural applications is not large and seems unlikely to increase without a major increase in housing starts or DIY projects. The market share in the western provinces would not appear large enough to support a mill specializing in siding production.

United States

The production and consumption of structural panels in the U.S. follows, in general, the same pattern as in Canada, and the large capacity for softwood plywood must be considered in any evaluation of potential markets for Canadian poplar panel products. Construction plywood dominates the market, with waferboard becoming increasingly significant. There is somewhat more use of non-structural panels, e.g., particleboard and MDF, in structural applications than in Canada but the very small volume of poplar plywood occasionally produced is of no significance.

The total construction plywood capacity was about 18.7 million cum in 1981/82, but is expected to decline to 17.2 million cum by 1990, of which 14.5 million or 84% will be for production of sheathing. The location of 55% (8.4 million cum) of sheathing capacity in the south, which has highly favourable wood, labour and transportation costs, is important to the Canadian waferboard industry.

Most forecasters agree that, because of anticipated increases in U.S. housing starts, the total consumption of plywood will increase to an average of 16,100,000 cum annually from 1985 - 1990, made up of 2.7 million cum of sanded plywood and 13.4 million cum of sheathing.

CHI estimates that the U.S. domestic consumption of construction plywood for all purposes will develop as follows:

Annual Consumption	Sanded	Sheathing	Total
1982 (cum)	2,511,000	11,400,000	13,911,000
1985 (cum)	2,500,000	12,991,000	15,491,000
1990 (cum)	2,300,000	13,050,000	15,350,000

The waferboard industry in the U.S. has expanded rapidly since 1974 and now comprises 11 plants with a total capacity of approximately 1.9 million cum.

In addition, four mills with a total capacity of about 500,000 cum, are in the final planning stage. None could be in operation before the last quarter of 1984. The U.S. industry will have a capacity advantage of about 600,000 cum over Canada by year end 1983 and could easily increase this by a further 300,000 cum within two years. Data Resources Inc. (DRI) forecasts that total U.S. structural composite capacity (waferboard, OSB, phenol bonded particleboard) will expand to 7.4 million cum by 1995.

At time of writing, published reports indicate that an additional 8 to 10 mills are being planned. No completion dates have been announced.

Acceptance of waferboard has been stimulated by the competitive pricing, as compared to CDX* plywood sheathing, and the proximity of Canadian mills to the north-central and northeast regions in the U.S. In Table 32 and Figure 10 the shift from an imported supply base to a high degree of self-sufficiency is obvious.

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*CDX is a designation for the lowest grade of U.S. coniferous plywood sheathing. There is no exact counterpart under CSA specifications, which do not permit veneers lower than 'C' grade. CDX pricing generally establishes the market price for other coniferous plywood and waferboard.

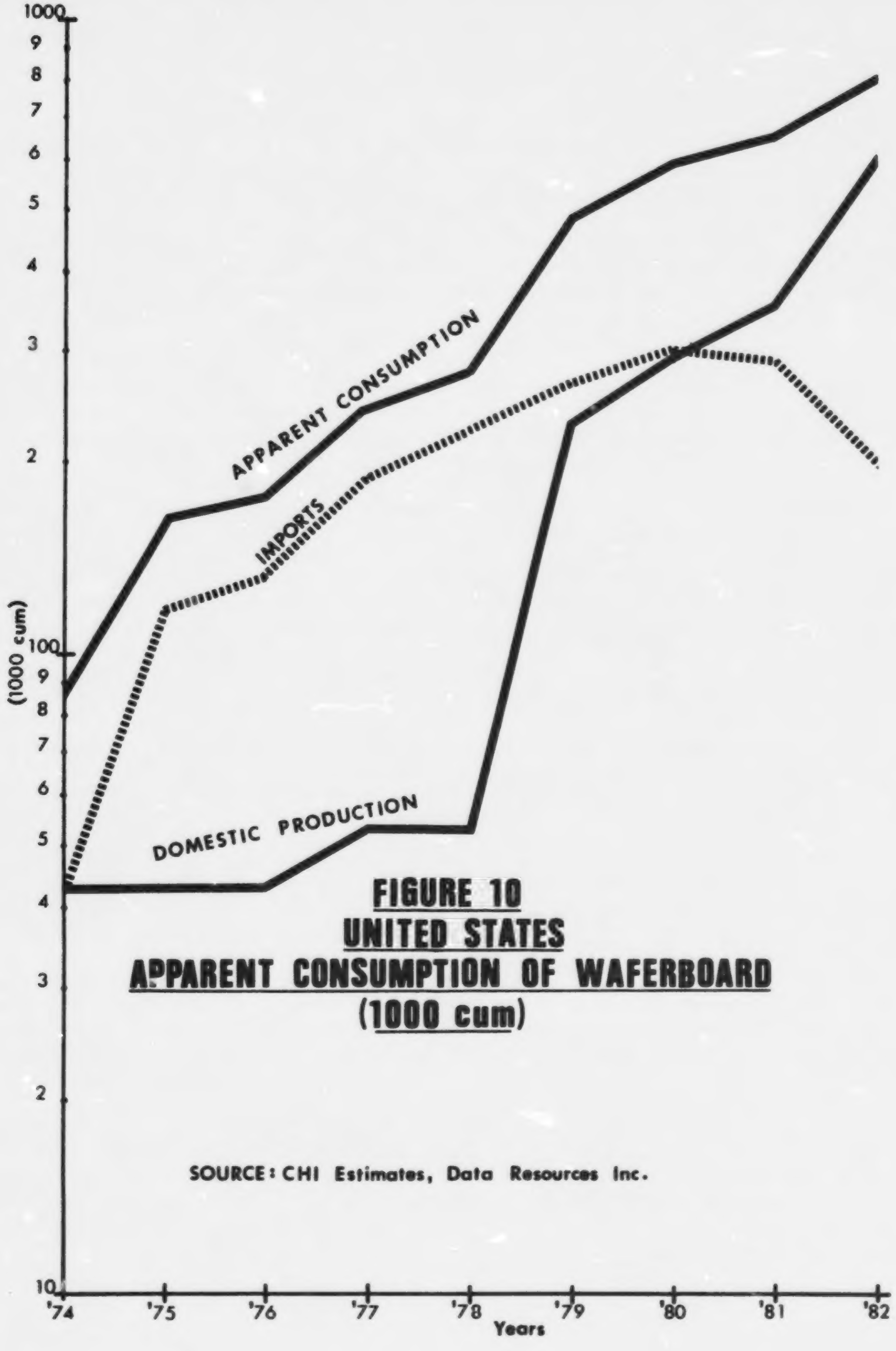

FIGURE 10
UNITED STATES
APPARENT CONSUMPTION OF WAFERBOARD
(1000 cum)

SOURCE: CHI Estimates, Data Resources Inc.

TABLE 32

UNITED STATES
APPARENT CONSUMPTION OF WAFERBOARD

(cum)

	Imports*	Domestic Production	Apparent Consumption
1974	44,130	44,000	88,130
1975	119,150	44,000	163,150
1976	132,400	44,000	176,400
1977	190,000	53,000	243,000
1978	225,500	53,000	278,500
1979	260,400	229,500	489,900
1980	300,000	291,300	591,300
1981	295,000	358,100	653,100
1982**	200,000	600,000	800,000

Source: CHI estimates; DRI.

*From Canada only.
**Estimated from data to July 31.

The above table allows for some OSB production. Comply panels, now produced in the U.S., are included in the production and consumption data for the last three years. The estimated output of these panels in 1982 is 60,000 cum (OSB) and 30,000 cum (Comply).

Future Demand

This discussion will concentrate on the relationship between construction plywood and waferboard. There is no meaningful data on the volume of insulating board used as sheathing, such as in Canada, although, it is a factor. The term "waferboard" will imply OSB, Comply and some exterior bonded particleboard.

Waferboard is clearly established in the U.S. market for several reasons:

a) It offers a competitively priced panel which can replace coniferous plywood in most applications.

b) Most building code authorities now accept waferboard.

c) There is a large reserve supply of poplar and other hardwoods located in proximity to the major marketing regions.

d) The relatively recent entry of major marketing companies into waferboard and OSB production will expand public awareness of the product.

However, there are regions such as the south, in which the level of panel usage is below that of others because of differences in house design. Waferboard may not exhibit the same degree of opportunity in the south, especially when the plywood industry there is considered. However, waferboard and OSB mills are planned for this region based, in some cases, on dense hardwood species.

The bulk of consumption to date has been for residential construction, while the potential markets for general construction, industrial, DIY, etc., are virtually undeveloped.

Practically all U.S. analysts are optimistic about waferboard, generally based on an expected sharp recovery in housing starts and the U.S. economy. U.S. consumption is exhibited in Table 33, which includes both structural and non-structural panels.

TABLE 33

UNITED STATES

ESTIMATED CONSUMPTION OF PANELS, ALL TYPES

(cum)

	Average		
	1976/80	1981/85	1986/90
Waferboard	459,000	1,624,000	4,042,400
Construction Plywood	16,222,400	11,510,300	14,907,300
Particleboard	5,575,200	5,361,600	6,031,700
Hardboard	2,145,000	2,300,000	2,650,000
Rigid Insulating Board	3,910,000	3,300,000	4,001,000
Total	28,311,600	24,095,900	31,632,400

Source: DRI, SRI, CHI estimates.

Waferboard is forecast by all observers to erode the market position of softwood plywood. The table includes panels which are not structural in the sense used in this report. Forecasts for particleboard and waferboard show strong growth trends. Hardboard is not forecast to show much change in annual consumption levels. The relatively strong increase in consumption of insulating board is partially caused by the acoustic and ceiling tile component which is utilized in all segments of the construction industry.

Using the above data, together with estimates by the U.S. Forest Service, CHI estimates U.S. consumption of panels will be as follows:

	1985 (thousand cum)	1990 (thousand cum)
Construction Plywood	15,500	15,400
Waferboard	1,600	4,000
Rigid Insulating Board	3,000	3,700
Particleboard	6,000	7,000
Hardboard	1,800	1,900
Total	27,900	32,000

The major Canadian structural panel with a potential for export to the U.S. is waferboard. It is shown in Table 27 that Canada exported an all time high of 52% (301,000 cum) of waferboard shipments in 1980, of which more than 95% was destined for the U.S. market. However, all indications point to the conclusion that Canada's position relative to existing and planned expansion of capacity in the U.S. will decline. DRI forecasts that from 1982, the ratio will decline to an average of 23% in the period 1981 - 1985, dropping to 13% in the period 1986 - 1990. In actual volumes, these translate into annual averages of 208,000 cum and 520,000 cum respectively, indicating a potential rate of growth in exports from Canada of about 10% annually to 1985 and then a decline to 5% to 1990.

A significant negative factor is the potential for increased utilization of mixed hardwoods to produce structural composites in the U.S.

The eastern and southeastern seaboard regions of the U.S. will be practically inaccessible from Alberta or B.C., since all competing mills are between western Canada and the major markets. Therefore, the market penetration from the western provinces must be towards the west coast and southwestern states.

Annual housing demand for new housing in the U.S. had been forecast to be 2.49 million units in the period 1980 - 1989. The south and west would account for 66% of the single family and multi-family units. Actual starts of these types were forecast at 1.58 million units in 1984, of which probably the west and south-west would account for 35% or 553,000. At an average use factor of 2.5 cum per unit for plywood and 0.50 cum of waferboard per start, the probable demand in the region becomes 1.4 million cum for plywood and 277,000 cum for waferboard. Considering the price advantage and the increasing replacement of plywood by waferboard, the possibility exists of a "western" market of about 300,000 cum annually for housing alone.

In addition, the non-residential market in the southwest and western region accounts for approximately 45% of the U.S. total, in which waferboard consumption is only about 25,000 cum annually but is increasing. Industrial and renovation consumption, estimated at 835,000 cum for the entire U.S., would add a further significant volume in this region.

Because of the disappearance of a significant portion of western plywood capacity and the slow development of other structural panel capacity in the region, the western U.S. offers some opportunity for western Canadian waferboard. However, the previously noted announcements may adversely affect Canada's chances.

Summary

Canadian waferboard will face increased competition in the U.S. market and its market share will decline. U.S. capacity will increase to satisfy demand and can be expected to utilize an increased volume of hardwoods which are located geographically and economically close to the major market regions.

In the near future waferboard mills in western Canada appear to have only the west and southwest regions open to further penetration. Some shipments are being made there now but will need to be increased when the third western Canadian mill comes on stream. There appears to be no significant opportunity for other Canadian structural panels in the U.S. market.

European Economic Community

The production and consumption of both structural and non-structural panels in the EEC accounts for a very significant portion of the world total. The pattern is complex because of the overlapping uses of the various panels and it may be useful to comment on each type of panel separately. Waferboard has been made only on a 'semi-experimental' basis in Europe and imports from Canada are minimal. To visualize the size of the total panel market into which waferboard must fit, the following comments are significant. It is impossible to segregate the major panel types into market shares according to structural and non-structural uses, so only those which most directly affect Canadian waferboard are considered here.

TABLE 34 EEC PLYWOOD INDUSTRY

PRODUCTION, TRADE AND CONSUMPTION, 1980

(thousand cum)

	Production	Exports	Imports	Consumption
Belgium - Luxemburg	55	113	239	181
Denmark	30	47	156	139
France	546	169	335	712
F.R. Germany	432	52	486	866
Greece	58	23	2	37
Ireland	-	1	33	32
Italy	400	88	123	435
Netherlands	45	42	488	491
United Kingdom	22	77	772	717
Total	1,588	612	2,634	3,610

Source: FAO, Yearbook of Forest Products, 1960, 1979, 1980.

Table 34 shows that total plywood production in 1980 decreased from 1970 by 16%, while plywood consumption increased by 9%. With the exception of the U.K. and Greece, imports have risen in the 10 year interval. France and Italy exhibit large plywood outputs which, in the latter country, contain significant volumes of poplar species. In all cases, the import data include a share of the 469,000 cum of coniferous plywood exported from Canada. Canada's share of the market was about 10%. Poplar plywood is not exported to the EEC in any significant quantity.

TABLE 35

EEC PARTICLEBOARD INDUSTRY
PRODUCTION, TRADE AND CONSUMPTION, 1980

(thousand cum)

	Production	Exports	Imports	Consumption
Belgium - Luxemburg	1,665	1,164	111	612
Denmark	317	41	135	411
France	2,166	372	386	2,180
F.R. Germany	6,262	660	971	6,573
Greece	289	5	2	286
Ireland	48	4	66	110
Italy	1,700	20	483	2,163
Netherlands	75	52	529	552
United Kingdom	613	41	1,280	1,852
Total	13,135	2,359	3,963	14,739

Source: FAO, Yearbook of Forest Products 1960, 1979, 1980.

It is apparent from Tables 34 and 35 that particleboard dominates the EEC panel market. The 1980 production volume is an increase of 66% over 1970 levels while consumption has increased by 81%. Germany is seen to be virtually self-sufficient in that imports and exports are nearly in balance and production is very large. The significant trends are in the U.K. where imports and consumption have nearly doubled in 10 years. France and Italy, with their large outputs, are very significant consumers.

Most of the production is interior quality, although widely used in construction. The value of all imports for 1980 is about US$1,571 million. Canada has exported only small volumes, including some waferboard.

At first glance, the EEC would appear to offer a market opportunity for waferboard. However, while some exports have been made from Canada, there are major problems which are still unresolved. On balance, shipments from western Canada do not appear to be attractive economically.

Specific data on the volume exported to the EEC from Canada are not reported but discussions with both producers and importers indicate the volume is well under 10,000 cum annually. This is in sharp contrast to the probable export of 342,000 cum of softwood plywood which will be shipped there from Canada in 1982. In addition, some 350,000 cum of sheathing grade plywood will probably be exported to the EEC from the U.S.

Most of the 600,000 cum of coniferous plywood from Canada and the U.S. will enter under the duty-free quota, while waferboard will face a tariff of about 11%*. Even with a lower production cost than for Canadian plywood sheathing, waferboard cannot meet the delivered price of U.S. CDX sheathing which is about 10% cheaper than Canadian sheathing in the EEC market. For example, in 1981 the price of Canadian waferboard, cif, in the U.K. was about $250/cum compared to the average for plywood sheathing, of $210 per cum.

Problems and opportunities for waferboard in the EEC may be summarized as follows:

There is a lack of specific knowledge of the product. It is generally considered as another form of particleboard and has not been widely accepted for the properties and uses which help to sell it in North America.

Technical data, relating to long-term aging, design and use factors etc., backed by national laboratory tests are important, especially in Germany and the United Kingdom. The Canadian Waferboard Association is developing and updating all technical data to meet these needs.

Potential problems of swelling and fungal attack when waferboard is used in flat roof systems, under tiles, are considered serious in the U.K. Recent information indicates that British code authorities (National House Building Council) now require all lumber framing and sheathing material to be treated with anti-fungal material before installation. This includes spruce lumber, CSP plywood, and waferboard. Douglas-fir plywood and asphalted sheathing are exempted. If this policy is adhered to, it can only increase the delivered costs of any of this material imported from Canada.

At competitive landed prices, the U.K. market could absorb more waferboard in housing, DIY and packaging at the expense of existing softwood plywood markets.

The Federal Republic of Germany, with its large particleboard industry, strict quality standards and building code, is a difficult market for waferboard, especially for housing and construction uses.

In France, the approvals of Centre Technique du Bois and the application of the AFNOR label (Association Francais Pour Normalisation) are essential to the penetration of the construction market by any sheet material, in order to provide a long term guarantee of quality for insurance purposes. France is probably a poor market for waferboard, considering its established plywood and particleboard industries.

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*See Appendix 6 - "Tariffs".

The timber frame housing market in France is relatively small, comprising only about 10% of housing starts, although the French government is promoting timber frame construction for low-cost housing. Softwood plywood and particleboard are both widely used for many construction purposes. "Exterior" particleboard is sometimes used for concrete forms and for cladding where direct exposure to weather is experienced. Prices for this particleboard are reported to be very competitive with softwood plywood.

France has only one softwood plywood mill, Ocean Ltee., but prices are high and consequently, relatively high levels of imports are purchased from North America, mostly for packaging. Potential, but limited, markets for waferboard are in DIY, packaging and perhaps agricultural buildings for which the National Standards do not apply and French softwood plywood is too costly.

Packaging and crating are, perhaps, the most promising end-use markets in the EEC, although the greater weight of waferboard tends to restrict this use. A very large volume of CSP plywood and Italian poplar plywood is now being used for this purpose.

The use of waferboard in restoration and renovation of dwellings and small structures probably can be developed. The DIY market in Europe is not yet developed to the degree found in North America, thereby reducing the potential for waferboard.

Rigid Insulating Board

The use of rigid insulating board in Europe directly affects the opportunity for waferboard. Non-compressed fibreboard is included in the fibreboard category shown in Appendix 4, Tables 80, 81 and 82. For the EEC, the trade balance shows a total imported volume of 1.08 million cum in 1980, compared to 942,000 in 1975. Much of this is from Scandinavia and the U.S.S.R. Average annual production in the EEC of non-compressed fibreboard totalled 375,000 in 1975, and 314,000 cum in 1980, including both decorative and sheathing panels. Canada's exports were minor, i.e., 109 tonnes in 1981 and 35 tonnes in the first seven months of 1982. The large supply available from within the EEC and both Scandinavia and the U.S.S.R., coupled with a loss of insulation board markets to chemical foam products, severely limits Canada's export opportunity in this region.

The widespread use of insulating board for structural uses in the United Kingdom is well established. Three types of fibreboard, hardboard, insulating board, and medium density fibreboard, are permissable under the United Kingdom code CP112, Part 5, Timber Frame Wall Design, to provide racking (shear) strength in the plane of the wall. Generally, the durability of fibre building boards, combined with economic cost, ensures that they will remain well entrenched.

The British consider insulating board acceptable for cladding, lining, dividing walls, etc., mainly on the basis of durability, since the sugars and starches in the wood fibre are removed in manufacturing operations. With a low equilibrium moisture content, they are considered to be virtually free from fungal attack. In general, they consider all fibreboard to have these properties. This advantage, according to the British authorities, is clearcut over waferboard made from poplar.

Summary

In summary, while there is a latent market for waferboard, the availability of particleboards, coniferous and hardwood plywoods, coupled with the traditional end-use applications, make the prospects for exporting large volumes of waferboard poor. The large supply of insulating board available from European sources effectively prohibit exports of such panels from Canada.

Southeast Asia

The very large production of wood-based panels in Southeast Asia limits the opportunitity for Canadian waferboard and other structural panels. This is because a considerable volume of the plywood output, all of which is hardwood, is bonded with exterior adhesive and both these and the non-exterior panels are intermingled to a considerable degree in the market.

Japan, South Korea, Taiwan, and Singapore all depend on extensive imports of sawlogs and veneer logs, primarily shorea (lauan) species, to supplement their own supply. The log producing countries, Indonesia, Malaysia and the Philippines, have embarked on programs to reduce log exports in favour of the establishment of the production facilities. The future allowable cuts will be reduced, leading to an increase in log values in the main producing countries. The import-dependent countries have, therefore, incurred extra costs of production and have had to look for logs in new areas.

In 1965, the Philippines were the major source of timber (logs and lumber combined) but supply from this source is now minimal, being replaced by Indonesia and Malaysia for hardwoods, and the U.S.S.R. and the U.S. for coniferous species. In 1981, Japan's timber imports totalled 33 million cum while the domestic supply was 31.37 million cum.

The FAO estimates that the volume of wood fibre for conversion into panels (all types) will represent 8.4% of the total converted for all purposes in Southeast Asia by the year 2000. The growth rate in consumption of plywood in the Southeast Asian region may be about 5% annually. Consumption of reconstituted panels is forecast to rise from 0.4 million cum in 1980 to 0.6 million cum in the year 2000.

Japan

Japan is essentially a plywood-oriented country, both in production and consumption. Imported veneer logs have been the mainstay of the Japanese industry which now faces major supply problems. Concurrent with the decline in log supply, there has been a severe decline in output due to the reduction in housing construction.

TABLE 36

JAPAN
PRODUCTION OF PLYWOOD

(cum)

Year	Total (all classes)	Veneer Core Only* Type I	Type II	Type III
1965	2,627,436	217,260	1,596,084	726,860
1970	6,922,020	2,239,000	4,396,340	114,152
1975	6,168,520	2,540,940	3,529,284	36,722
1980	8,001,972	4,123,956	3,774,608	15,420
1981**	7,800,000	n/a	n/a	n/a
1982**	7,400,000	n/a	n/a	n/a

Source: Japan Forestry Agency.

Notes:
*Veneer core is about 95% of total.
**Estimated by CHI.
"n/a" - Not available.

Adhesives are classified in three categories:

Type I — Fully water-proof. For use in exterior applications and must meet boiling, and soaking test procedures. Glue is usually a phenol-formaldehyde or a urea-melamine mixture.

Type II — Highly water-proof. May be used in areas of high temperature or dampness. Urea glue is commonly used.

Type III — Normal water resistance. This plywood is used for "comparatively dry areas" where only low water resistance is required. The glue is usually an urea extended with a flour or casein.

Most Japanese plywood is of an all veneer construction, the remainder being either lumber core, particleboard, or a special core type. Since 1965 production of type I plywood (waterproof) has risen from less than 10% of production to 52% in 1980 so that production is practically split between Type I & II, (Table 36). This reflects the levelling out of log supply and the shift to production of construction grade plywood for the domestic market, at the expense of the formerly large volume of exports which were nearly all thin, decorative types. Type I plywood, which includes all thicknesses, and the commonly produced 914mm x 1829mm (3'x6') panel, is the type with which Canadian coniferous plywood and waferboard must compete in price and quality to gain acceptance. Concrete form plywood of 12 mm thickness or greater is an important element in Type I now. Probably only 35 - 40% of the Japanese capacity is in 1,220 mm widths - the balance is limited to 914 mm.

Plywood Imports and Exports

The trading balance of the Japanese plywood industry has undergone significant changes. From the position of that of a major exporter of plywood, Japan has passed to the position where production and domestic consumption have seriously declined. The estimated consumption in 1982 is 7.4 million cum, with imports and exports approximately in balance at an estimated 50,000 cum each.

Canada's share of the volume imported represents about 25% of the total and shows signs of increasing in 1982. In addition, token shipments of Canadian waferboard have been made, but the results are not conclusive. Imports of coniferous plywood from North America are practically all from the Canadian and U.S. west coast.

TABLE 37 CANADA - CONIFEROUS PLYWOOD EXPORTS TO JAPAN

(value thousand C$, fob Canadian port)

	1980			1981			1982 (Oct.)		
	cum	value	$per cum	cum	value	$per cum	cum	value	$per cum
Douglas-fir	10,200	2,333	229.00	7,438	1,944	261.00	7,238	1,634	226.00
CSP	15,812	3,446	218.00	10,607	2,467	233.00	10,289	2,043	199.00
Total	26,012	5,779		18,045	4,411		17,527	3,677	

Source: Statistics Canada

U.S. trade data indicate that, in the same period, an average annual volume of about 6,000 cum, practically all Douglas-fir plywood, was exported, valued at about C$2.5 million each year.

Housing Market

Future consumption of wood-based panels depends to a large degree on residential housing starts. In Japan, traditional houses have employed very large volumes of wood material, carefully cut and fitted together according to old time craftsmanship. Table 38 shows the recent strongly negative trend in housing starts and also the development of the so-called "2 x 4 system" houses.

TABLE 38

JAPAN
NEW HOUSING STARTS

(Number of Units)

	Total	2x4 construction (incl. in Total)	Type of Structure	
			Wooden	Non-Wooden
1970	1,484,556	n/a	1,035,500	449,056
1971	1,463,760	n/a	967,105	496,655
1972	1,819,802	n/a	1,112,805	706,997
1973	1,905,112	n/a	1,120,484	784,628
1974	1,316,100	(396)	869,637	446,463
1975	1,356,286	(3,229)	907,389	448,897
1976	1,523,844	(5,043)	992,966	530,878
1977	1,508,260	(5,625)	946,489	561,771
1978	1,549,362	(6,184)	958,158	591,204
1979	1,493,023	(11,000)	908,534	583,489
1980	1,268,626	(13,100)	750,653	517,973
1981	1,151,699	(13,500)	653,647	498,052
1982	1,130,000	(16,000)	n/a	n/a

Source: Japan Forestry Agency, Japan Construction Association.

The Canadian industry, supported by Provincial and Federal programs, is working to increase the number of timber frame units with the objective of increasing the export of coniferous lumber and plywood. Although the plywood exported represents less than 1% of Japanese consumption, the trend is positive. The U.S. has been somewhat less successful.

The pronounced decline in housing starts in Japan is not conducive to rapid expansion of exports of structural panels from Canada. Problems relating to grades, details of standard test methods, physical properties, applications under the building code, inspection procedures, tariffs and traditional building methods have been formidable. Recent announcements indicate some easing in access is imminent. However, the Japanese plywood and construction industry, faced with major economic problems, is not yet ready to have large volumes of coniferous plywood and composite panels imported into the country. Imports from the ASEAN countries will be important for many years to come, reaching a forecast level of 2.9 million cum in the year 2000. However, a shortage is probable. If Japanese housing recovers from the present low, to the very high requirement of 2.3 million starts per year, the consumption of wood products will increase beyond the capacity of the domestic industry to supply demand.

Summary

There appears to be a moderate potential for waferboard in Japan although market development will be a long process.

The long term requirement for housing and probable shortages of construction plywood in Japan indicate additional imports of coniferous plywood are likely. Assuming economics are favourable, waferboard made in Alberta or B.C. could be offered. It is realized, however, that the key Canadian exporters are also plywood producers so that a change in marketing strategy would be required.

The average landed cost of Canadian softwood plywood in Japan would be about C$285 per cum, including 15% Japanese tariff and an estimated C$60 per cum for ocean freight, based on the October, 1982 value, fob, of C $194 for CSP as reported by Statistics Canada.

Waferboard, assuming it is made in western Canada, would have to meet or better this delivered cost. CHI estimates the cost structure as follows:

	$ per cum
Production Cost*	135
Freight	75
Duty (18%)	25
Total	235

*Before profit margin.

Waferboard should be offered as a sheathing in both traditional, 2 x 4 and prefabricated house construction systems; concrete form grades (as they are developed) and a utility panel for the general construction trade. The possibility of cutting panels to a 3' x 6' module should be considered. There is also a large market for crating and packaging for the automotive and machinery industry, for which heavier panels are required.

Korea

Data on Korea's plywood and particleboard industry are shown in the non-structural section of this report, since the industries concerned relate mainly to the furniture sectors and production of panelling. There appears to be no opportunity for waferboard or rigid insulating board in the forseeable future as the note, below, on housing suggests. Plywood is widely used in the industrial applications and is protected by tariffs.

There is some knowledge of waferboard by plywood producers who are seeking alternative investments because of the poor prospects for long term log supply. Two executives expressed interest in a joint venture in western Canada and were given an outline of Canadian waferboard economics. However, the opportunity is remote at this time and, if pursued, would be directed to a North American market rather than Korean.

Korea recently dispatched a housing mission to Canada to survey timber frame construction techniques, under the auspices of the Department of Industry, Trade and Commerce, Ottawa. One of the largest Korean companies, which includes a large construction subsidiary, has discussed timber frame construction with a Canadian architect. The company appreciates the utility of timber frame, but the traditional steel and concrete homes and the numerous 20-25 storey housing complexes are well entrenched in the construction industry. A long term program will be needed to convert prospective buyers. Few all-wooden houses are seen in densely populated Seoul, which contains 8.5 million people, 25% of the Korean total. Financing would be a problem, as would the purchase of land except at considerable distances from the core of the cities. Data for 1981 indicate that only 111 "wooden" buildings were to be constructed out of a total of 3,473. About 30% of the total were dwellings.

Singapore

Singapore has established a very important wood processing industry based entirely on imported, duty-free raw material while capitalizing on its strategic location on shipping routes and an abundant labour supply. While not large compared to other industries, the wood processing group is a significant factor in the manufacturing economy with a value of C $800 million in 1981.

The rapid growth of timber industries in the neighbouring countries has led to a scarcity in the supply of raw materials and this has affected the industry in Singapore, particularly the sawmilling and plywood sectors which have developed extensive secondary manufacturing elements.

In 1982 the industry comprised 40 sawmills, 16 plywood and plywood overlay plants, 2 particleboard plants, one sliced-veneer plant, 31 knocked-down furniture plants and 35 moulding plants. There were also 7 kiln-drying and timber preservation plants.

Over the last 20 years the Singapore plywood industry has been modernized and has increased its capacity for prefinishing imported panels and reduced the volume of panels produced from imported logs. As shown in Appendix 4, Tables 80, 81 and 82, Singapore is a major exporter of plywood (616,000 cum in 1980). Imports from other Southeast Asian countries are important sources of supply, especially for prefinishing. Plywood imported for direct consumption either in furniture or construction totalled 265,235 cum, valued at S$150 million in 1981. An indeterminate volume was of structural quality.

Included in the plywood industry are mills which overlay particleboard, blockboard and gypsum with films and fancy veneers. Some of these would be considered millwork plants in Canada.

Decorative plywoods, are sold in the EEC, Scandinavian, Middle East and Australian markets.

The standard size of plywood panels is 2440 mm x 1220 mm, but all types of cut-to-size are available. The end-users are kitchen cabinet fabricators, furniture and building construction industries. The panels are also made for marine uses, shuttering panels, core panelling and blockboards.

Plain plywood, which includes structural types, represented 83% of exports and would account for a large share of the structural panels shipped to the U.K. Singapore plywood is competitive with Canadian coniferous plywood in the U.K. and Europe, with the advantage of entry at a low rate of duty under the General System of Preferences applied to assist developing nations.

Canada's share of the panel trade is minimal, consisting of 149 cum of veneer in 1981. The consensus is that waferboard is unlikely to penetrate the market easily, due to a probable delivered cost disadvantage and the regional production of structural plywood in sufficient volumes to supply the construction trade for the foreseeable future. In common with consumers in most Asian countries, there is a negative reaction in Singapore to the textured appearance of waferboard when compared to lauan plywood. North American sheathing plywoods create the same reaction.

Taiwan

The Taiwan panel industry is essentially non-structural so general statistical data are included in the non-structural section of the report. However, structural uses are satisfied by the current production of plywood.

Waferboard is unlikely to be sold in Taiwan because of the tariff factor and the large volume of plywood made there which is consumed for the same purposes for which waferboard would be offered. Because of population density, dwellings, are for the most part, located in multi-storey concrete structures. Even in rural areas, the typical residences and farm structures employ concrete and masonry to a large degree.

Hong Kong

Waferboard exhibits a poor prospect for any large volume of sales of waferboard in Hong Kong while structural plywood is still economically available from Singapore and other Southeast Asian countries. Asian plywoods are well established for the concrete form application. The high rise type of structure dominates the construction sector so that concrete form plywood is the major panel used structurally. In addition, probable transportation costs would probably be too great a portion of delivered costs.

PARTICLEBOARD AND MDF

Regional Markets

Canada

The Canadian particleboard industry has performed well over the past five years, having recovered from a period of intense competition from U.S. imports, to a position where exports are now significant. Table 39 illustrates the overall trends in production and consumption of particleboard for all uses.

The industry, based originally on poplar roundwood, developed in Ontario and Quebec to supply the expanding millwork and furniture industries of the region. One mill operated in southern Manitoba from approximately 1964-1970, before closing down due to pressure from U.S. imports. Several others, including one large size mill in New Brunswick, followed the same path. The use of poplar roundwood at a high cost was a negative factor in each case. The operating mills are now generally supplied with sawmill waste as the "furnish". Several are less than three years old, using modern technology to obtain very favourable costs. This is especially true of the thin particleboard or "thinboard" mills.

TABLE 39

CANADA

INDUSTRIAL PARTICLEBOARD*

PRODUCTION, SHIPMENTS, CONSUMPTION

(cum)

		Shipments				Apparent
	Production	Exports	Domestic	Total	Imports	Consumption
1970	283,318	neg	255,958	255,958	40,600	296,558
1971	301,744	14,749	275,958	290,708	70,796	346,754
1972	419,932	87,758	307,522	395,280	120,944	428,466
1973	442,477	104,719	355,457	460,176	197,230	552,687
1974	392,879	92,900	265,507	358,407	238,410	503,917
1975	352,507	15,100	351,249	366,349	173,874	525,123
1976	493,942	7,481	466,071	473,552	135,473	601,544
1977	518,397	22,895	490,822	513,717	94,193	585,015
1978	638,146	35,500	581,465	616,965	58,997	640,462
1979	709,827	75,608	627,647	703,255	55,546	683,193
1980	721,231	113,651	610,181	723,832	49,904	660,085
1981	714,916	90,846	606,642	697,488	21,029	627,671
1982	561,873	120,897	452,786	573,683	39,402	492,188

Source: Statistics Canada, CHI files, interviews.

Note: *Includes all types and thicknesses of urea-formaldehyde bonded particleboard.

The volume produced in 1982 was about 50% of the capacity of about 1 million cum at that time. Total capacity in 1983 is estimated as 1.1 million cum, including the large mill under construction in the Gaspe, Quebec region. B.C. accounts for 197,000 cum of total capacity, including a thinboard mill with a capacity of 57,000 cum. Thinboard now accounts for 209,000 cum or 20% of total Canadian capacity. There are no mills between Grand Forks, B.C. and Atikokan, Ontario. Table 40 lists the Canadian particleboard mills and shows the types of presses with which each is equipped.

TABLE 40

CANADA
INDUSTRIAL PARTICLEBOARD MILLS
ESTIMATED CAPACITY TO YEAR END, 1983

Company	Location	Type of Press	Annual Capacity
MacMillan Bloedel	Vancouver, B.C.	Standard-Platen	103,200
Parta Industries	Grand Forks, B.C.	Standard-Platen	36,900
Northwest Panelboard	Smithers, B.C.	Thin-Platen*	57,000
Pluswood Inc.	Atikokan, Ont.	(1) Standard-Platen (2) Thin-Drum (3) Thin-Drum	59,000 36,900 29,500
Levesque Plywood	Hearst, Ont.	Standard-Platen	106,200
Rexwood Products	New Liskeard, Ont.	Standard-Platen	73,800
New Ontario Dynamics	New Liskeard, Ont.	Standard-Platen	29,500
Malette Panelboard	Timmins, Ont.	(1) Standard-Platen (2) Thin-Platen*	10,000 57,000
Domtar Inc.	Huntsville, Ont.	Standard-Platen	73,800
Sogefor Ltee.	Lac des Iles, Que.	(1) Standard-Platen	148,000
Flakeboard Ltd.	Milltown, N.B.	(1) Standard-Platen (2) Thin-Drum	60,000 29,500
Newfoundland Fibrply	St. John's, Nfld.	Standard-Platen	22,000
Kunz	Sayabec, Que.	Standard-Platen*	118,000
			1,050,300

*Single opening press

Total domestic shipments of 452,786 cum account for 81% of total production in 1982, a drop from 1981 when they represented 85%. Eastern Canada, which contains most of the furniture and prefinishing plants, logically takes the largest share of industrial particleboard shipments of about 76% of the total. Quebec contains a higher ratio of commercial and institutional furnishing operations than does Ontario, which concentrates on kitchen cabinet and household furnishing plants. It is estimated by CHI that about 4% of the total shipments to eastern Canada originate in B.C. Some is low density door core and some is produced with exterior adhesive.

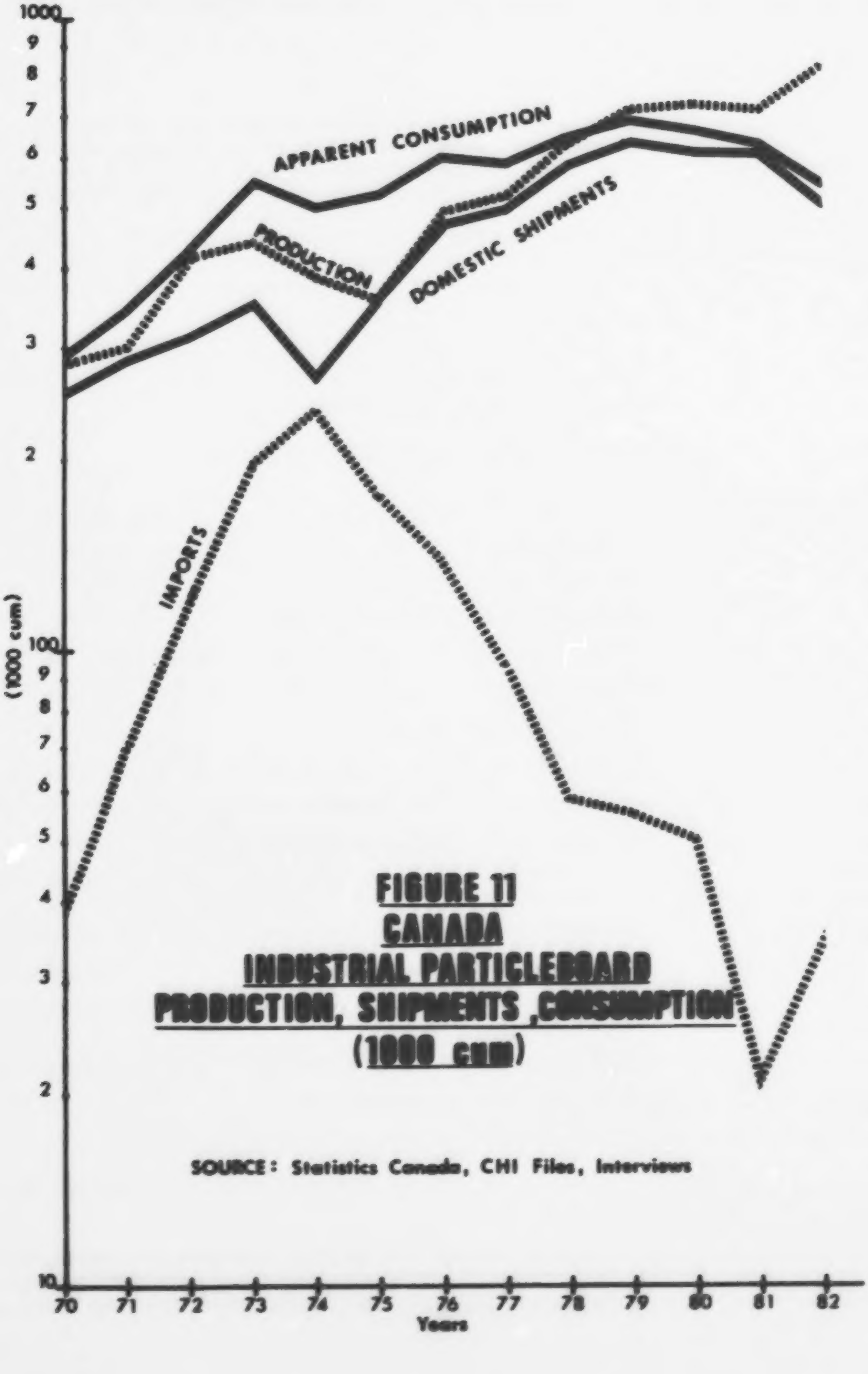

FIGURE 11
CANADA
INDUSTRIAL PARTICLEBOARD
PRODUCTION, SHIPMENTS ,CONSUMPTION
(1000 cum)

SOURCE: Statistics Canada, CHI Files, Interviews

In the period 1974 - 1977, up to 33% of consumption was imported at very low prices from the western U.S. This caused serious problems for the eastern Canadian industry. The low price resulted from an abundance of low cost sawmill and plywood mill waste in the western U.S. which could be economically converted to particleboard. However, the demand for wood material for both energy and pulpmill furnish, combined with a reduction in the volume available because of improved sawmill efficiencies, has increased the value of "waste" in the U.S. The present cost of manufacture of particleboard in the U.S., combined with freight, currency exchange rates and Canadian tariffs, has reduced margins for U.S. particleboard in the Canadian market.

The effect of MDF on the Canadian market for particleboard used in the non structural sector is important. Table 41 shows the estimated volume of both panels consumed in the furniture, cabinet, prefinishing etc. industries in Canada.

TABLE 41 CANADA

APPARENT CONSUMPTION OF INDUSTRIAL PARTICLEBOARD AND MDF

(cum)

	Particleboard	MDF	Consumption Total (Rounded)
1970	237,200	n/a	237,200
1971	277,400	n/a	277,400
1972	342,800	n/a	342,800
1973	442,200	n/a	442,200
1974	403,400	25,000*	428,400
1975	420,100	28,000	430,100
1976	499,300	31,000	530,300
1977	491,500	34,000	525,500
1978	544,400	38,000	582,400
1979	594,400	42,000	636,400
1980	594,100	47,000	641,100
1981	577,200	52,000	628,200
1982	492,200	40,000	497,200

Source: Statistics Canada.

*Estimated CHI. Excludes the volume consumed in structural applications.

There have been few recent studies of the complex market for industrial particleboard in Canada and, considering the increase in consumption of both thin panels and MDF, the data from industry are helpful but not conclusive.

Apparent consumption increased at an average annual rate of 7.4% from 1970 - 1981, whereas it was growing at a rate of 10.8% in the period 1970 - 1976. Part of the recent decline in the particleboard sector may be attributable to the increasing imports of MDF, which are estimated at about 52,000 cum in 1982 and growing by 11% annually. Practically all of the imported MDF, which became significant about 1973, consists of thicker panels. As shown above in Table 41, 9% or 40,000 cum of the total particleboard consumption in 1982 was estimated to be MDF and, of this, probably less than 9,000 cum was consumed in B.C. and Alberta. The total consumption of all types of domestic particleboard in the two western provinces is probably less than 70,000 cum annually, to which should be added an estimated 15% or 6,000 cum of imported MDF, indicating an apparent consumption of both panels of about 76,000 cum or 14% of the Canadian total in 1982.

To make an estimate of Canada's particleboard and MDF consumption by sector, the data in a report made in 1975* has been used as a basis for distribution of the panels according to the sector in which they were utilized in 1981.

Industry Group	Volume (cum)	%
Prefinishing	201,000	32.0
Sash, Door, Millwork	18,900	3.0
Prefabricated Homes	25,200	4.0
Mobile Homes	62,900	10.0
Kitchen Cabinets	50,300	8.0
Household Furniture	106,900	17.0
Office Furniture	18,900	3.0
Miscellaneous Furniture	37,700	6.0
Retail Sales and Others	106,900	17.0
Total	628,700	100.0

Note: Values rounded.

The values above are approximate but, in CHI's judgment, are reasonably indicative of the combined use of industrial particleboard and MDF in Canada. MDF is of minor importance in the prefinishing, mobile home and retail sectors, although it could penetrate these to a greater degree if available in larger volumes.

The value of particleboard and particleboard products consumed in secondary manufacturing is significant and has increased rapidly from $39 million to $64 million in two years. The total value in 1980 represents 28% of the value of all wood-based panels consumed by the secondary manufacturing sector.

Canadian mills enjoy a competitive edge over particleboard imported from the U.S. west coast of about $50 per cum. Price trends are shown in the section on price considerations.

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*"Canadian Market Potential for Industrial Particleboard and Particleboard Products" DITC, Ottawa, 1975. Columbia Engineering International.

End-Uses

Major markets for industrial particleboard are the kitchen cabinet, home and office furniture, counter top, shelving, floor underlay, store fixture, and general industrial sectors. Generally, in these industries, the panels are relatively thick - from 9 mm to 25.4 mm - and a significant volume, 75%, is eventually finished with various overlays - vinyl, melamine, polyester sheets, or may be printed, painted, stained, etc. to give a decorative effect. Some is overlaid with decorative veneer either by furniture manufacturers or hardwood plywood mills. A significant volume is cut-to-size, either at the producing mill or by the secondary fabricator.

Thin panels are used mainly as a substrate on which to print or bond paper overlays to make decorative wall panels. Thin particleboard also substitutes, in the plain form, for hardboard and unfinished imported lauan plywood in uses such as furniture components - backs, drawer bottoms, etc.

Included in the 25% of unfinished particleboard is the volume consumed as underlayment, i.e., used in a "structural" sense, and some of the thin particleboard which is used in hidden elements in furniture manufacture such as a back or cover. Thinboard is in competition with hardboard for these uses.

MDF, as explained in a following section, is taking over a substantial portion of the industrial particleboard market in which it is employed, to varying degrees, for all of the uses above.

The type of panel, which eventually finds its way to the consumer, either individually through direct sale at the retail level or indirectly through the purchase of furniture, is characterized by the type of finish applied.

a) Unfinished Panels

These panels may be sanded or unsanded, and may be cut-to-size for various uses such as utility panels or shelving panels. Both of these are usually marketed as a DIY item at the retail level.

Unfinished particleboard is also sold for incorporation into structures for shelving, or for general hidden "non-structural" uses by all types of building contractors. In this case, the panels are usually sold in the full size (1220 x 2440 mm).

b) Unfinished and/or Filled Panels

These panels are produced as the first stage of manufacture and are upgraded at either the particleboard mill (in its finishing department) or in a furniture, millwork or custom finishing plant. The panel is characteristically smooth textured, with an even and generally light colour, probably sanded with a well controlled density, specific to the customer's requirements. Important characteristics are that edges are smooth, corners not brittle and thickness tolerances are maintained. Screw holding properties are important. It is in these properties that MDF excels and is replacing particleboard.

c) Finished Panels

Particleboard panels are used in a vertical application, e.g., wall panelling, counter fronts, cabinet walls, etc., or horizontally as a surface where resistance to wear and abrasion is required. An important characteristic of particleboard is that the basic panel can be cut and/or finished in a variety of ways. The same range of finishes can be applied, of course, to poplar plywood, hardwood plywood, hardboard and, for some uses, gypsum board.

For finished thicker panels, particleboard and MDF are now the dominant types. For wall panelling (4-6 mm thick), hardboard and lauan plywood have dominated the market, but are now losing out to thin particleboard.

Moulded and Extruded Panels

Included in the numerous methods of producing particleboards and MDF are the concepts of:

(a) moulding a complex item and,

(b) extruding an essentially flat panel.

Neither system is in use in Canada at this time but a few specialty plants exist in the U.S.

Moulded Panels

Particleboard and MDF may be pressed into various shapes such as compartmented boxes, containers and structural items, e.g., studs, timbers, table tops with curved or profiled edges and finished millwork items of various shapes. The processes are technically exacting and only economic for higher-valued items such as casing, millwork or where large production runs of items, such as in moulded pallets, are required. The costs of making dies, specific to each item, are significant factors.

The use of poplar in moulded panel production is probably impractical unless very large markets and a source of low cost raw material are available. It is conceivable, though, that a specialty line for MDF siding or trim items could be incorporated in a standard MDF plant. MDF siding may be given a patterned surface during the pressing operation and would be sold in competition with hardboard siding.

Extruded Panels

The extrusion process for particleboard relates to a system in which the furnish is forced in a continuous flow by a ramming method between the heated press plates. The press configuration is single opening, generally with the two platens erected vertically. The gap between the plates is fixed to produce a given panel thickness. Rods may be fixed between the platens to conduct heat and these produce a series of hollow tubes within the finished panel. These tubes provide a means of enclosing cables, conduits, etc., in a finished wall section.

There was one such mill built in New Brunswick. The capacity was low, operation intermittent and the mill is now closed. About four extrusion mills operate in the U.S., the U.K. and Germany.

Market profiles for extruded panels, which are employed as door cores, moveable and fixed partition walls and for various general utility applications, are not conducive to production in Canada for some time to come.

Exports

Exports of particleboard to the U.S. have shown a strong upward trend since 1978 to the level of 120,897 cum in 1982, representing 21% of all shipments. The growth rate is about 23% annually in the period 1978 - 1982. Thin particleboard makes up almost 33% of the total exports. While the high growth rate may not be sustained, a strong, long term growth is probable.

The exports from the west are mainly thin panels, estimated to total about 4,000 cum, and are all from one mill in B.C. and are shipped to the western states.

Practically all of the estimated 81,000 cum of thick panels which will be exported in 1982 will come from the eastern provinces. Mills in this region are attempting to improve their export markets for thick panels, expecially in the U.S.

As noted in the section on the EEC, the extensive U.S.S.R. and European particleboard industries, together with prohibitive tariffs, precludes any large scale exports from western Canada. However, MDF shows some potential, as shown later.

Future Demand

The historical trend in the rate of growth of consumption of particleboard was 8.3% annually, with a decline beginning in 1981 and 1982. Based on previous estimates, the general trend up to 1985 has been established at 7% annually which CHI considers reasonable. At the same time, the volume of MDF will probably continue to expand by at least the present 10% rate annually.

In our judgment, the demand for the two industrial panels will be about 825,000 cum in 1985, of which MDF will represent approximately 76,000 cum.

One particleboard mill is under construction in Quebec, for start-up in 1983, with an annual capacity of about 118,000 cum, designed primarily for the EEC market. While some of this output will very probably be sold in Canada, it is unlikely to be sold in the western provinces in competition with particleboard made west of Winnipeg. It will, however, reduce the volume shipped to eastern Canada from the west.

Assuming the level of consumption in the west remains the same as at present, the probable consumption in the four western provinces, the Yukon and the North West Territories by 1985 will be as follows:

	1985 (cum)	Source (1982 Basis)
Standard Board	158,000	Domestic production in B.C., Ontario, imports
Thinboard	15,000	Domestic production in B.C., Ontario, imports.
MDF	15,000	Imports.
Total	188,000	

The opportunity for large volume shipments of plain particleboard, from B.C. and Alberta to the east, is limited. However, some prefinished thin particleboard is shipped, following secondary processing in Vancouver.

Summary

Particleboard and MDF demand will be strong in Canada, with increasing export market opportunities over the next 10 years. Thin particleboard should continue to compete with imported thin plywood panels from the Orient and plain hardboard from both imported and domestic sources.

The western U.S. industry will probably never re-capture its major share of the Canadian market. For western Canada, poplar can be used in particleboard manufacture but whether it is economical, when supplied to a mill in roundwood form only, is a question.

Future average annual consumption trends of particleboard and MDF are summarized below in Table 42.

TABLE 42 CANADA

FUTURE AVERAGE ANNUAL CONSUMPTION OF PARTICLEBOARD AND MDF

	(thousand cum)	
Market	1981-86	1986-91
Domestic - Industrial - PB	700	1,000
Domestic - Industrial - MDF	70	150
Domestic - Structural - PB	50	-
Exports - Industrial - PB	120	200
Exports - Industrial - Thinboard	30	1,390
Total	970	1,390

*CHI estimates.

The estimates are based on current rates of increase. Potential exports to Asia and the U.K. (for MDF) are not included, so the total demand is considered conservative.

As will be seen when the Asian markets are reviewed, a potential for exports may exist but this will probably require a supplemental source of residual wood from other operations since the production economics of particleboard or MDF Mills limit the purchase of roundwood.

United States

The panels referred to in this section are flat (platen) or drum pressed particleboard products, of which 97% is bonded with urea-formaldehyde resin. In 1980, there were 53 operating mills distributed as follows: in the south and east, 32 mills; in the west, 21.

These mills shipped 5.2 million cum of particleboard in 1980 valued at US$531 million. The industry trend from 1975 onward is shown in Table 43. Particleboard consumption in 1981 was practically the same as 1980, but 14% below the 1978 peak. Particleboard consumption between 1976 and 1980 averaged 5.771 million cum per year, compared to 5.070 million in the early 1970's, an increase of 13%.

TABLE 43

UNITED STATES
INDUSTRIAL PARTICLEBOARD
PRODUCTION, SHIPMENTS, AND CONSUMPTION
(thousand cum)

	Production	Domestic Shipments	Exports	Imports	Domestic Consumption
1974	5,492	5,050	240	n/a	5,053
1975	4,494	4,292	179	n/a	4,295
1976	5,668	5,457	170	n/a	5,460
1977	6,359	6,157	133	n/a	6,161
1978	6,842	6,419	165	n/a	6,424
1979	6,258	5,799	178	n/a	5,804
1980	5,361	4,995	226	400	5,395
1981*	5,300	5,008	248	405	5,413
1982*	5,300	5,044	125	250	5,169

Source: National Particleboard Association.
U.S. Department of Commerce; Imports, Exports.
DRI

*Data estimated.

The downward trend in capacity, which has dropped from 7.4 million cum in 1974 to 6.6 million in 1982, is due to several factors:

(a) Closure of several older, uneconomic mills.

(b) Adverse changes in volume and value of raw material supply (i.e., by-products of sawmills, plywood mills, etc.).

(c) Conversion of some plants to MDF and waferboard production.

The effect of MDF in the U.S. market is significant and must be considered in examining the particleboard industry. The volume of mill shipments of MDF in 1980 is reported as 872,814 cum (77% of MDF capacity) with a value of US$ 531 million. There are eleven MDF mills with an annual capacity of 1.130 million cum, two of which are in Oregon and Montana and which supply most of Canada's MDF consumption.

Of significance to the markets for western Canadian particleboard and/or MDF is the concentration of mills in the northwest U.S., which are strategically placed between B.C./Alberta and the potential markets. Western U.S. mills shipped a total of 2.250 million cum of particleboard plus 329,000 cum of MDF in 1980. When transportation and duty factors are evaluated, the potential for export from Canada is minimal.

The use of particleboard in the U.S. generally exhibits the same pattern as in Canada.

Future Demand

There have been several forecasts of long-term demand for particleboard in the U.S. The U.S. Forest Service projected* a consumption of 8.7 million cum in 1980, rising to 10.9 million in 1990. This, however, includes waferboard, MDF and some exports. SRI** projects a total consumption of 10.6 million cum in 1990, from a base of 7.6 million in 1978 - an annual rate of increase of 3%. This includes all classes of panels.

DRI***, in its FORSIM projections, develops a projection (excluding residential and non-residential uses, considered to be structural) which indicates an annual rate of increase of 2.5% to 1990.

In the judgment of CHI, the 2.5% growth rate for industrial particleboard is probably correct for the next five years and if the economy recovers by 1985 as seems probable, the rate of increase will be greater, perhaps to 3% annually.

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*Monograph on the U.S. Market for Wood Based Panels. ECE Symposium, Helsinki, 1980.

**SRI, Forest Products Planning Service, December, 1981.

***DRI, FORSIM, July, 1982.

With the advent of additional waferboard capacity, the particleboard industry will concentrate more and more on the industrial markets. Some of the increased demand will be supplied by MDF which, at this time, has a capacity surplus of only 200,000 cum (18%). This suggests additional capacity may be built or that exports to Canada and elsewhere may be curtailed in order to supply the domestic market. In CHI's judgment, the consumption of MDF will exceed the annual rate for standard industrial particleboard by 10%, i.e., the annual rate will be 2.75% from the 1980 level of 885,000 cum.

In addition to the probable increase in domestic consumption, the general opinion of U.S. forecasters is that export markets will increase by 200% from 1978 to 1983. In the period 1986 - 1990, DRI expects the average annual volume of exports to be about 391,000 cum. CHI considers this optimistic since Canada received almost 60% of the total in 1981. In our judgment, this volume can be easily supplied from Canadian sources. Nevertheless, for the purpose of this study, we will assume the higher value to be correct. The Canadian share of MDF exports is about 35,000 cum or about 28% of the expected annual total shown in Table 43. Much of this could be replaced from Canadian sources.

In summarizing the above factors, the annual average demand during the five year period 1986 - 1990 develops as follows:

TABLE 44

UNITED STATES

UREA PARTICLEBOARD AND MDF

AVERAGE ANNUAL DEMAND

1986 - 1990

(thousand cum)

	Industrial	Structural	Total
Urea Particleboard			
Repairs/Alterations	1,132.7	-	1,132.7
Other*	247.8	1,592.9	1,840.7
Manufacturing	3,079.6	-	3,079.6
Exports	391.0	-	391.0
Sub-Total	4,851.1	1,592.9	6,444.0
MDF			
Manufacturing (**siding, etc.)	865.5	93.0	958.5
Exports	129.5	-	129.5
Sub-Total	995.0	93.0	1,088.0
Total	5,846.1	1,685.9	7,532.0

*underlay, sub-flooring, general construction, (non-waferboard)

**CHI estimates about 10% of total manufacturing.

Table 44 indicates that the U.S. capacity to produce these panels will be strained over the next five years. As of early 1983, no significant increases in capacity are forecast for either type of panel. With the indicated increase in demand, the level of capacity utilization will approach 90 to 95%.

One of the problems will be the oversupply of underlayment grade in the southern states, combined with a shortage of industrial grades in the west. This indicates MDF will continue to occupy an increasingly significant position since it can be made from a wide range of species and forms of wood material.

Price Factors

From the point of view of the western provinces, the critical price considerations are those of the western U.S. for underlayment and industrial grades. Both have been fluctuating recently but are expected to increase dramatically due to the probable increases in wood, resin and energy costs.

The underlayment grade establishes the price level in both the U.S. and in the eastern Canadian market where it is sold, in some cases as a low cost core panel. The price for this grade exhibits wide fluctuations. It peaked at $112 in 1980, then dropped to $75 before recovering to the relatively stable level of $112 in 1982. DRI projects a price increase amounting to 118% for western industrial grades between 1981 and 1985. While DRI also forecasts annual fluctuations, the trend of the price increase is strongly upward to 1990.

At the current level, the delivered price of underlay grade in Alberta is about C$160 per cum at the distributor or industrial purchaser level.

Summary

The general cost trend and supply balance in the northwest U.S. appears to offer continued opportunity for exports of thin particleboard from Canada, at least from the eastern provinces. It is highly possible that the same opportunity is available for another mill in B.C. or Alberta to supply the western U.S. market, which consumed about 130,000 cum of panels under 6.35 mm thick in 1980, and 141,000 cum in 1979.

There is an export of about 70,000 cum of MDF to Canada each year, of which about 15,000 cum is re-exported through Vancouver. Practically all of this comes from the Pacific Northwest. When this is viewed in the light of U.S. exports to Europe and the Far East, combined with probable U.S. cost increases, it indicates a favourable situation for western Canada.

Considering current production costs of particleboard, which average about $120 per cum, before freight and duty are applied, there does not seem to be any chance of selling standard panels into the Pacific Northwest states. If poplar roundwood was employed, the opportunity would be even less. However, if the projected price trends do occur, western Canadian mills would have an opportunity, providing low cost wood is available. Planned reductions in U.S. tariffs under the GATT will assist in expanding future markets for Canada.

European Economic Community

The data shown in Table 33 and Appendix 4, Tables 80, 81 and 82, illustrate the problem Canada, especially the west, faces in exporting particleboard to the EEC. The size of the industry within the community and in the neighbouring countries makes the EEC, as a unit, practically self-sufficient. There are, however, long term problems in low cost wood supply which may change this situation after another five years.

The effect of European-made particleboard in the construction industry and the effect on waferboard has already been noted. Particleboard is made and used in the EEC for non-structural applications, with a much greater variety of surface treatments and additives than in Canada. These include treatments against fungal attacks, flame spread and fire resistant overlays of all types. Moulded and shaped panels and a multiplicity of cut-to-size panels are offered by the producer for market sectors which include mobile homes, furniture, displays, shop and office fittings, toys, miscellaneous industrial applications, repair, maintenance, retail sales, etc.

MDF is an important element of the EEC panel trade. Consumption tripled between 1978 to 1981 when it was about 157,000 cum. Since then the use of MDF has increased. Of significance to Canada is the flow of about 20% of consumption from the U.S. (31,000 cum in 1979), of which a large portion came from Oregon via Vancouver. New Zealand accounts for about 5% of the total supply.

Estimates from various sources indicate that by 1985 the consumption of MDF will be approximately 740,000 cum, of which the U.S. will continue to be a major supplier although several mills now operate in Europe. For the UK alone, consumption of MDF is expected to rise by 137% from 1981 to 1984.

The U.K. market, which can be used as a guide to Canada's chances in the EEC market, was forecast to show an increase in consumption of standard and finished particleboard to 1,989,000 cum by year-end 1982. Imports were calculated at 1,412,000 cum, which included only 0.4% from Canada, including some waferboard. Scandinavia and other European countries completely dominate the market at prices well below Canadian prices, by as much as 40% in some cases. Production from U.K. sources amounts to about 25% of consumption. This share is apparently declining while imports have increased by about 15% annually over the last two years.

In 1981, Canada exported only about 6,000 cum and most of this was shipped from the east. Melamine overlaid panels, cut-to-size and shelving items make up an indeterminate proportion of the shipments which do not contain any plain, standard panels.

Summary

The EEC market for particleboard offers very little opportunity for poplar-based particleboard in the immediate future. The MDF component of the "particleboard" market may, however, offer a more positive chance. MDF produced in Canada, at competitive prices, could capitalize on the strong demand and perhaps, also, replace current shipments from the U.S.

Japan

Japan has an expanding particleboard industry with a reported production of 273,000 cum in 1970, rising to 1.022 million cum in 1981. Most of this is consumed as a core for decorative and furniture panels.

Production in 1982 was estimated at 1.1 million cum, rising at about 5% annually. A small volume, 75,000 cum, is imported and a token volume exported. While published data refers to imports of particleboard, discussion in Japan strongly suggests this material is mainly MDF. Most of the production is consumed domestically.

The particleboard industry will probably be the area of greatest growth for Japanese panel products. FAO estimates that the consumption of softwood-based particleboard will be 5,000,000 cum per annum by the year 2000. This seems to be very optimistic as it implies a growth rate well above the current level. A major constraint lies in the wood material base. While the production of coniferous timber is expected to increase, it probably will not permit the diversion of all of the substantial volume required for such a large particleboard industry in competition with the pulp mills.

Assuming that the 5% rate of increase holds, by 1990 consumption would be about 1.6 million cum while imports of particleboard or MDF would be about 120,000 cum or more, equivalent to the annual output of a large capacity mill.

In addition to the domestic output, Japan now secures MDF from the U.S. and New Zealand. This latter country exported 2,908 cum to Japan in 1980/81 at an average unit value of US$299 per cum, in addition to shipping particleboard totalling 8,906 cum at US$ 154 per cum.

Summary

The Japanese furniture and millwork industries might offer an opportunity for Canada to export particleboard and MDF if western Canadian wood costs are sufficiently low.

Long term demand for particleboard is excellent and the advantages of the MDF panel in the furniture and cabinet industries would be apparent to the Japanese. CHI estimates the landed cost of western Canadian MDF would be as follows:

	C$/cum
Cost (fob mill)*	160.00
Freight	60.00
Duty (18%)	22.00
Landed, cif	242.00

*Before profit margin.

Korea

Korea now depends very heavily on Malaysia for its veneer log supply and, therefore, will face serious shortages of timber during the next few years. The effect on the Korean plywood industry will be of major proportions and will further increase the industry's and the government's efforts to secure log supplies elsewhere. Particleboard and MDF are being considered as replacements for plywood.

While Korea imposes a high rate of tariffs on most products, other than primary materials, there are indications that dependency on various types of semi-finished imports is growing.

Of interest to this report are the imports of pulpwood (chips/particles) totalling 3,074 tonnes in 1981 from the U.S., representing about 14% of the total imported (22,400 tonnes) from all sources. Australia was the major supplier with 88% of the total.

Panels imported in 1981 included hardboard from China and Japan and about 850,000 cum of plywood from various countries. New Zealand shipped 2,500 cum of particleboard in 1980 and 793 cum in 1981.

During the past two decades, Korean plywood, mainly thin panels used as print bases and utility panels, was sold at a relatively low price. However, because of timber prices in Indonesia and Malaysia and increases in cost of oil and labour, the Korean plywood industry is changing from general panel production into high quality, specialty plywood and the processing of custom-made products.

At this time, Korea produces panels of the following types: plain, prefinished, printed, paper overlaid, paper and vinyl laminated and high grade veneer faced panels. The cores may be of veneers or particleboard.

Most of the mills operate sawmills and furniture operations in conjunction with the plywood operation and several have offices and/or mills in Indonesia and Malaysia.

Production capacity peaked in 1978 at 3.0 million cum when 94 plywood mills, of which 16 were significant producers, operated. These were located, generally, at the major ports of Pusan, Gunsan and Inchon to service the export market. Currently, the mills are operating at a 65% capacity level and produced only 1.5 million cum in 1982. Several major bankruptcies have occurred.

The Plywood Association is attempting to reduce mill outputs by agreement between the companies. The industry is uncertain as to the direction it should take in the future and there is some interest in more joint ventures overseas. Some of these, although in the plywood sector, are conceived as investment opportunities rather than as a supply for the Korean domestic market.

Korea, for some time, was rated as the world's largest producer of plywood and certainly has been one of the largest plywood exporters on a global scale. In particular, Korean plywood has been a major factor in North America, especially Canada. Lauan panels have supplied the majority of the panels used in the prefinished and low-cost panelling industry together with a sizeable proportion of thin panels used in the general industrial and DIY sectors. While shipments to North America and Europe have declined, those to the Middle East have increased. Nevertheless, Korea's portion in this panel trade is declining.

Canada formerly purchased large volumes of plywood from Korea, amounting to 112,000 cum in 1977 but, because of the reasons enumerated for other Asian hardwood plywood production, the pattern has been altered radically. For 1982 the probable total of plywood imported by Canada from Korea would be 13,000 cum. The class "unfinished", which represents 62% of total, is being replaced by hardboards and thin particleboards, both of which can be delivered in western Canada for prefinishing at prices well below the indicated wholesale price of lauan plywood produced in Korea. Unfinished lauan would be priced at about C$ 450 per cum, delivered in Vancouver, at the end of 1982.

There are only three particleboard operations in Korea, all associated with plywood mills which produce millwork and furniture panels with a particleboard core. The data on these industries shown in Appendix 4, Tables 80, 81 and 82 indicates they are relatively small. Imports are minimal, and production is considered to be in balance with demand.

As a result of discussions and analysis of trade data, the following products appear to have a potential for B.C. and Alberta in the Korean market.

A specific inquiry and request for sample poplar logs from western Canada was made by the Poplar Producer's Association. Associated with this type of production from plantation grown poplar are ice-cream spoons, tongue depressors, matches, lunch boxes, chopsticks, etc. In all cases, a veneer is made as the primary stage of manufacture. While the total volume consumed is small with respect to the surplus of poplar in B.C. and Alberta, it may be worth while following up this inquiry.

While a high tariff rate of 20% exists and no firm statistics are available, it appears that the New Zealand export of "chipboard" to Korea may be largely MDF, which could be utilized in panels for re-export under a duty drawback arrangement. There is a definite interest in MDF in Korea from the export oriented furniture and cabinet making industries.

Summary

Korea is pursuing a policy of securing long term timber supplies from foreign sources by long term contracts or direct investment. Because of serious problems in the plywood industry, there is a strong interest in joint venture participation in foreign countries.

Industrial particleboard and MDF panels are imported from several regions to support the Korean furniture industry, even though tariffs are restrictive. An opportunity for western Canada may exist if the tariff problem can be overcome.

Singapore

There are three particleboard mills in Singapore, one of which produces plywood also. Total capacity is small, amounting to less than 100,000 cum annually. Production was well below capacity in 1982. Current mill sales value was quoted as C$215 per cum but subject to heavy discounts.

The internal consumption of particleboard is impossible to determine with accuracy. Imports in 1981 are estimated to total 27,000 cum but, in all probability, MDF is included in this. Imports range from 5 mm to 25 mm in thickness and 66% is overlaid. New Zealand, Australia and the U.S. are primary sources. Exports of particleboard probably do not exceed 6,000 cum for the year, while production is about 50,000 cum. On this basis, consumption for all purposes, but mainly for incorporation into furniture and cabinets, which are then exported, would total about 70,000 cum at current levels. Considering the generally favourable trend in the furniture industry, this volume will probably increase and will include an increasingly large component of MDF. MDF is not identified in trade data, but is imported and utilized in the furniture plants.

The 31 mechanized and automated furniture plants, which produce practically all of their output in knock-down forms, have maintained a high level of output during the current recession. Total output was valued at about S$110 million in 1981, of which 90% was exported in knock-down condition.

Product lines include living room, dining room, bedroom sets, kitchen counters, cabinets, miscellaneous desk styles, chairs and occasional items of all types. Panels consumed may be plywood, plain or overlaid; particleboard, plain or overlaid; and solid wood laminates and blockboards. MDF, now imported from New Zealand, will become more widely used in the future, according to industry spokesman.

In addition to the panels employed, there is a large volume of Asian hardwoods used in lumber form for exposed surfaces, arms, legs, etc. These are supplemented now by North American and European ash, southern pine and western U.S. alder. Lower grades of alder and southern pine are used for blocking, corner braces, inside frames, etc., which leads to the possibility that western Canadian alder, poplar and birch might be utilized.

The markets for furniture in 1981 were mainly in North America. Of the total, Canada imported 11% by value, worth approximately C$5 million.

Summary

The large primary and secondary wood industries in Singapore face supply problems because they are dependent on imported timber. Other than plywood, the production of industrial panels is very low and most supplies are imported, including particleboard and MDF. These are now purchased, in part, from Australia, New Zealand and the U.S., which indicates that an opportunity for western Canada may exist. The most favourable chance for western Canadian penetration of the market in Singapore appears to be in particleboard and/or MDF. These panels are being employed increasingly in the furniture trade which is the most buoyant wood products sector. Furthermore, the cost of plywood will continue to increase while log supplies become more difficult to obtain, opening the door to the use of thin particleboards for prefinishing and for the furniture industry.

Based on probable production costs in western Canada particleboards might be delivered to Singapore on the following basis (C$ per cum).

	Standard Particleboard	MDF
Cost (fob mill)	120.00	160.00
Freight	70.00	72.00
	190.00	232.00
Aveerage cif cost (1982)*	175 - 215	280.00

* Source: Singapore Import Statistics

Of the two panels, MDF would appear to offer the best opportunity.

Taiwan

Taiwan has built up an impressive export trade in panel products, mainly plywood, based on a relatively small domestic timber supply. Log imports exceeded US$620 million in 1982 and are expected to increase.

Taiwan produced an estimated 850,000 cum of timber, both coniferous and deciduous, from its own forests and imported about 6 million cum for a consumption of 6.85 million cum in 1981. The wood-based industry is becoming more and more dependent upon the roundwood imports, nearly all of which is hardwood, from Indonesia, Malaysia and the Philippines. Approximately 60% of the imported roundwood is processed into plywood.

The dependency of Taiwan's industry on log supplies from Indonesia (34%) and Malaysia (60%) is a cause for concern. The plywood industry alone would appear to require about 3.0 million cum of peelable logs plus an added volume of imported veneer annually at current levels of output.

Historical data on the industrial particleboard industry are neither readily available nor accurate. However, discussions with officials in Taipei indicate that 1982 production totalled 15,000 cum with an additional imported volume of 19,000 cum. The consumption total was about 34,000 compared to 40,000 cum in 1981.

TABLE 45 TAIWAN

SOURCE OF PARTICLEBOARD IMPORTS, 1981

	Volume cum	Value thousand US$
U.S.	4,305	876
New Zealand	15,733	3,504
Australia	197	47
Japan	941	248
Philippines	49	10
Others	n/a	n/a
Total	25,252	5,325

For 1982, the probable import levels will be US$4.0 million for a volume of 18,600 cum. The recession has reduced the demand for furniture and this, in turn, has reduced consumption of particleboard.

The domestic consumption of plywood and composite panels in Taiwan mainly results from the very large furniture, cabinet and fixture industries.. They produce every conceivable kind of cabinet, furniture, sporting goods and woodenwares. Practically all of this production is for export. When the other wood-based manufactured goods industries are added to this, the total value of exports was US$714 million in 1980, indicating an annual rate of increase in excess of 25% since 1975. According to those interviewed, the future trend is equally positive. The data are shown in Table 46.

TABLE 46

TAIWAN

EXPORT OF WOOD PRODUCTS

(thousand US$)

	1975	1976	1977	1978	1979	1980
Woodenware	153,165	175,759	199,992	179,251	355,045	384,354
Wood Furniture	45,174	64,365	94,213	219,670	316,453	329,243
Total	198,339	240,124	294,142	498,921	671,498	713,597

Of the exports, shown in the table, 42% was shipped to North America, of which 83% was consumed in the U.S. A large percentage of the furniture is shipped in the "knock-down" stage in containers for final assembly in strategically located plants in the country of destination.

Taiwan cannot afford to lose this market and will take every opportunity to obtain raw material to maintain the sector which comprises over 300 major companies, with a labour force of about 125,000.

While there are no official data on MDF imports and production, there is one MDF mill in operation with a theoretical capacity of 100,000 cum, but, reported to be operating well below this. Plywood industry sources estimate the volume of imported MDF is 33,000 cum annually and that this will increase. CHI estimates the MDF consumption for 1982 at 73,000 cum, of which 40,000 cum was produced domestically and 33,000 cum imported. Exports were about 10,000 cum.

MDF imports from various sources are included in the data for particleboard and hardboard. New Zealand exported 648 cum to Taiwan in 1981, valued at about C$300 per cum delivered.

In addition, there is a very large plywood industry which produces all classes of plywood, made almost entirely with non-coniferous species. Differentiation into structural and non-structural types is difficult.

There are now about 65 mills in operation compared to 80 mills which operated in 1979 with outputs as shown in Table 47 below. The volume of production is about 11% of the total Asian production.

TABLE 47

TAIWAN

PLYWOOD INDUSTRY - PRODUCTION AND EXPORTS

	Production	Exports*		
		Volume (thousand cum)	Value (thousand US$)	Value (US$per cum)
1970	794	589	79,133	134
1975	1,023	768	131,887	165
1980	1,400	864	371,912	430
1981	1,451	950	398,478	420

Source: FAO, yearbook 1980.
Central Bank of China (data 1977 - 1981).

*Includes blockboard; Imports are negligible.

The range of plywoods produced includes all types of plain and prefinished panels based on lauan, ramin, kapur, birch, spruce and decorative hardwood species, some of which is veneer from eastern Canada.

Discussions suggest that several of the producers will rely more and more on composite cores, e.g., particleboard, thin particleboard and MDF, as raw material for plywood and furniture panels at the expense of veneer core. In this way, they can overcome the probable deficiency in veneers produced from imported Southeast Asian logs. Taiwan's interest lies in fabricating various raw materials into panels utilizing its advantageous labour force at home. Western Canada may well be in a position to supply composite core material.

More than 60%, some 900,000 cum, of the plywood output is exported each year, accounting for 23% of the total export from Asia and 20% of the total hardwood plywood trade on a world-wide basis. The U.S. absorbed 34.3% of Taiwan's plywood exports in 1981, while Canada purchased 2.9%.

The cost of lauan plywood from Taiwan exported to Canada in either 1220 x 2440 mm or in doorskin sizes has escalated to the point where domestically produced thin particleboard has replaced it to a large extent. This situation is probably irreversible since the Taiwanese log supply is now interruptible and costly. Because Taiwan has been the major supplier of lauan, the substitution will be of major benefit to the thinboard industry, especially in western Canada.

Summary

Reconstituted wood-based panels for both the decorative plywood and furniture industries are being imported by Taiwan as noted. The Taiwanese producers are open to new supply lines which may, possibly, originate in western Canada. Estimated delivered costs of particleboard and MDF, assuming each was made in western Canada, are C$200 per cum and C$250 per cum respectively, before profit margin for the producer. These are in the general price range for particleboard and MDF imported in 1981. This suggests an opportunity which should be investigated.

Hong Kong

The Hong Kong market, as it relates to the poplar species of interest to this study, is essentially that of a consumer of raw material or semi-processed material. Panels will be either further processed in the colony and re-exported as part of a finished item or processed for the domestic market.

Plywood is made in one or two small units located in furniture plants. High quality face veneers are applied to various types of core panels in these operations. Annual production of plywood is estimated at 10,000 cum.

The market for imported logs and all types of wood products is primarily based on the Southeast Asian species - lauan, meranti, ramin, etc., so that Canada's share of the total is small. Logs, squares and lumber consumed in 1982 are estimated at 693,000 cum.

Panel products imported in 1982 exhibit the following pattern:

TABLE 48

HONG KONG

IMPORTS OF PANEL PRODUCTS

	Volume	Estimated Value C$
Veneer sheets (sm)*	3,119,074	2,688,000
Plywood (sm)	27,897,861	86,372,000
Reconstituted Wood (sm)	250,000	1,082,000
Blockboard, etc. (sm)	802,603	3,500,000
Hardboard (sm)	286,404	262,000
Insulating Fibreboard (sm)	517,678	700,000
Other Fibreboards (kg)	1,562,580	1,731,000
Total		96,355,000

Source: Hong Kong Department of Statistics.

Note: *These statistics do not define thickness basis; reported in square metres only.

The very small volume of plywood imported from Canada and the U.S. is a mixture of coniferous and hardwood plywood (birch). About 20,000 sm was imported from northern Europe, probably mainly birch. New Zealand shipped about 250,000 sm of plywood in 1982, estimated to be radiata pine.

The reconstituted wood panels were obtained from sources such as Thailand (74,000 sm), New Zealand (62,000 sm), Australia (38,000 sm), China (35,000 sm), Taiwan (10,000 sm), Italy, France, Germany and Norway. Probably some of these are MDF.

Fibreboards were obtained similarly from numerous sources, of which Europe was the major supplier, followed by South Africa, Yugoslavia, Japan and Taiwan. Included in these are some MDF panels, which are not identified separately in trade data.

The annualized value of all imports for 1982 is about C$317 million and although data are not complete this appears close to the total for 1981. Canada's share is very small but possibly could be increased in composite panels providing our production costs are such as to offset the relatively high freight costs to Hong Kong.

Hong Kong exported approximately C$16 million in value of various panels of which 90% was plywood. About 80%, by value, was shipped to the Peoples Republic of China which appears to absorb 30% of the total panel exports from Hong Kong.

Over and above the volumes exported annually, Hong Kong probably will require increasing volumes of panels to supply the remanufacturing industry and, especially, the very active construction industry. Numerous major projects such as subways, tunnels, roadways and high-rise buildings, are under construction or are committed for start-up. In July 1982 there were 25 new government tenders for various structures together with about 40 tenders for other projects, including high-rise office and residential buildings, bus depots, schools and factories. The total value of tenders in the month was about HK$2.0 billion. Land is expensive, so high-rise, high density structures are common. The forecast is for continuous replacement of older structures and the building of more new ones. On this basis, demand for all types of construction material, furniture, etc. will expand.

Summary

Hong Kong is a dynamic market for all classes of wood-based material. There are some opportunities for exporting Canadian softwood plywood, particleboard and MDF. The industrial manufacturing industry produces an extensive range of wood products such as furniture, cabinets, etc., which are exported to most world markets. Hong Kong provides a gateway to the markets in the Peoples' Republic of China.

For the same reasons that apply to plywood throughout the Southeast Asian region, i.e., supply and preference for the surface appearance, colour and grade, it does not seem that construction grade plywood from Canada will be of significant volume for some time to come. This could be changed if the plywood supply from Asian countries was severely curtailed. Such an event would provide an opportunity for concrete form plywood or waferboard for construction.

The best chance in the immediate future seems to be exports of thin particleboard and MDF for the furniture and millwork industries. The total volume imported from all sources is roughly estimated by CHI at 6,000 cum for each year of 1981 and 1982, to which could be added a large volume of the hardboard and other fibreboards. The total market potential, perhaps, is of the order of 15,000 cum.

The cost of delivering these products from western Canadian mills would be approximately as shown in Table 49.

TABLE 49 ESTIMATED COSTS OF CANADIAN PANELS IN HONG KONG

(C$ per cum)

	fob Mill*	Freight	cif Delivered
Sheathing Plywood (9.5 mm)	180.00	60.00	240.00
Waferboard (9.5 mm)	130.00	65.00	195.00
Particleboard	120.00	65.00	185.00
MDF	160.00	70.00	230.00
Hardboard	190.00	80.00	270.00

*Before profit margin.

The value of reconstituted wood imported from Canada in 1981 appears to be about C$ 200-250 per cum, depending on average thickness. The value of New Zealand's exports of MDF to Hong Kong in 1981 was about C$250.00 per cum, as shown in New Zealand Export Statistics.

HARDBOARD

Regional Markets

Canada

The Canadian hardboard industry comprises four mills operated by three companies, with a total annual capacity of 235,000 cum, producing about 200,000 cum per year up to 1980, following which a sharp drop has occurred. Imports account for about 10% of consumption. Table 50 lists the mills and annual capacities.

TABLE 50 CANADA

HARDBOARD INDUSTRY

ESTIMATED CAPACITY, 1982

	Capacity cum
Masonite of Canada, Gatineau, Quebec) Masonite of Canada, East River, Nova Scotia)	145,000
MacMillan Bloedel, Sturgeon Falls, Ontario	30,000
Canadian Forest Products, New Westminster, B.C.	60,000
Total	235,000

Each mill concentrates to a large degree in a specialized line of products. For example, Masonite, Nova Scotia produces decorative panels, standard and oil-tempered brown boards and doorskins, while its Gatineau, Quebec mill produces siding panels almost exclusively. The MacMillan Bloedel mill at Sturgeon Falls, Ontario also specializes in siding panels. Canadian Forest Products in New Westminster does not have a press long enough for siding panels and, therefore, specializes in standard 4' x 8' panels, both plain and prefinished.

The industry has not expanded its capacity during the past 10 years, but has changed the relative proportions of the products. In 1970, 66% of production was either siding or plain brown board. The balance was produced as prefinished panelling in the hardboard mills, and some of the brown board was also prefinished at other establishments. The total Canadian consumption of prefinished hardboard has declined by an estimated 50% since 1972 to about 87,000 cum, which includes doorskins and wall panels. Industry capacity is in balance with total shipments, which were about 230,000 cum in 1980.

The production and consumption pattern for the industry is shown in Table 51.

TABLE 51

CANADA
HARDBOARD PRODUCTION AND CONSUMPTION

		Imports		Exports		
	Production Volume (thousand cum)	Volume (thousand cum)	Value (thousand $)	Volume (thousand cum)	Value (thousand $)	Domestic Consumption Volume (thousand cum)
1970	176.5	16.7	2,026	47.8	5,667	95.3
1971	199.9	20.7	2,528	39.0	4,834	181.6
1972	232.8	27.1	3,189	60.6	9,593	199.4
1973	256.0	43.5	4,510	68.5	13,428	231.0
1974	245.8	36.2	6,412	37.4	9,123	244.6
1975	175.6	24.2	5,595	19.9	4,037	179.9
1976	207.4	33.6	8,380	15.8	3,084	225.2
1977	184.7	36.6	8,413	13.8	3,179	207.6
1978	210.8	42.5	9,249	17.5	4,675	235.8
1979	205.1	56.3	13,642	19.1	5,503	218.0
1980	204.5	43.6	12,824	29.3	10,334	219.0
1981	160.0*	51.0	16,545	27.1	10,400	188.1

Source: Statistics Canada; 1982 data not conclusive.

*CHI estimate.

There is an erratic trend in production and domestic consumption due to the changes in product mix. Industrial and siding production has increased by 25% over the ten years up to 1980, and this trend probably is still valid except for a probable decline in 1982. Most of this output is directed to the housing industry. Hardboard siding production now represents about 50% of industry capacity for all products and is shipped, primarily, to the domestic market.

Oil-treated or tempered boards are utilized in industrial remanufacturing processes, in the furniture, fixture and general millwork category. The secondary manufacturing sector consumes about $16 million in value of hardboard annually. Household furniture and the millwork industries consume almost 70% of this. It is in this application that a large volume of the imported panels compete.

The production of prefinished panels naturally relates to the residential housing starts, renovation and low rise commercial building sectors, with a strong element of retail sales for the DIY trade. This class represented about 10% of output in 1978, but is not now identified. It may only be 5% of total output currently.

Prefinished panels, consisting of both printed and embossed hardboards, find a ready market in the mobile home and prefabricated building industries. Hardboard may be made with embossed features imprinted to give a three-dimensional quality to the surface by using special plates which impart a pattern during the pressing operation. Patterns such as wood grains, imitation brick, stone, shiplap and plank effects are now commonplace. Door skins and sidings may be prefinished in the same manner. On average, about 18% of shipments were prefinished over the last five years.

It is highly unlikely that any additional wet process hardboard mills will be built in Canada due to the introduction of thin particleboard panels. The wet process hardboard mills produce a large volume of suspended fibres in the water medium which must be drained to the sewers and this now requires a substantial investment in two and three-stage settling and extraction systems because of environmental considerations.

Export Markets

Table 51 shows that exports represented almost 28% of total Canadian output in the early 1970's but have dropped to about 17% of output, at a volume of 27,000 cum in 1981. Practically all exports are of plain or tempered panels for industrial plants, including automotive and doorskin panels. The major export market is the U.S. which absorbs over 90% of the volume. There are numerous relatively small shipments to the EEC, Middle East, Scandinavia, Southeast Asia, Australia, and Central America. These overseas shipments include, for the most part, some prefinished panelling, and occasionally, siding panels and doorskins. Considering the productive capacity in the EEC, the U.S. and cost of delivery to Southeast Asia, CHI concludes the chances for additional exports are minimal.

Imports

Hardboard is made in many countries as an industrial panel or as a panel to be used in a semi-structural sense. It is widely traded in world commodity markets and this has had a braking effect on the Canadian industry over the years. An inspection of Table 49 shows the relatively large share of the domestic market taken by imports (mainly brown board), amounting to about 26% of consumption in 1979. Much of the volume of imported panels is used in the prefinishing mills in both Vancouver and eastern Canada to produce low cost, decorative wall panels with either a paper overlay, or a painted, embossed or printed-face pattern.

The U.S. is the largest supplier to the Canadian market, shipping 60 - 65% of the import volume although Brazil, Argentina, and the U.S.S.R. are important.

The base price for hardboard in plain and doorskin panels is established by the delivered value of imports. The basic price for 1981-1982 has been established by imports from the U.S.S.R. which are delivered at about $166 per cum, equivalent to the average production cost in Canadian mills. This, coupled with delivered prices of thin particleboard in eastern Canada, have seriously disrupted the Canadian industry.

The plain hardboard panel market is affected by imports not only of hardboard, but by lauan plywood panels from Southeast Asia and, recently, by the increasing volume of thin particleboard.

Thin particleboards can be produced with a smooth face on both sides at a much lower cost than hardboard and are penetrating the pre-finished panel markets. However, they are not embossed at the press so, even though domestically made hardboard panels are losing out in the general prefinishing market, they will hold their share of the embossed panel market.

Other competition comes from the gypsum panels commonly applied to most walls in new homes. They provide more flexibility in the purchaser's choice of initial colour and finish than does a prefinished panel, which may not suit the planned decor. Gypsum will continue to be important. Future demand for hardboard in Canada will probably not change significantly although some expansion in siding panels may occur.

Summary

The Canadian hardboard industry now consists of four mills each of which specializes in one or two marketable products. Production of standard brown board is relatively small and most of this is imported from the U.S.S.R. and Europe. Thin particleboard appears to be successfully competing with standard hardboard in the industrial and the prefinishing sectors. CHI foresees no growth in the industry, especially based on the poplar species in western Canada.

United States

The U.S. is one of the world's largest producers of hardboard, controlling about one-third of the total capacity at 2.341 million cum, of which 36% or 843,000 cum consists of dry process facilities.

The U.S. industry has 10 mills in the southern States, utilizing coniferous and hardwood waste material, including forest thinnings and low cost roundwood. Six mills are located in the northeastern States while the balance of nine mills are in the western region. Two of the mills, individually, have a capacity greater than the Canadian total.

The U.S. industry produced 1.8 million cum over the past three years which is an utilization rate of about 78%. Exports are minimal at about 45,000 cum and imports average about 130,000 cum. These values all represent declines from the peak years of 1977 - 1979. A gradual increase in output is foreseen by most observers.

Canada's share of imports in 1980 was 24% of the total, but this has declined to 14% in 1981 and approximately 10% in 1982.

Siding represented almost 50% of total consumption of hardboard in 1981 and it is estimated that the ratio will be slightly higher (52%) in 1984. Siding is a major product in the U.S. and, therefore, does not appear to offer an opportunity for Canada.

The non-siding element includes the standard brown boards consumed in millwork, furniture and miscellaneous industrial operations, together with retail sales for the DIY trade. Prefinished panels (plain, embossed, etc.) absorb a large volume of the standard panels, but this use will be influenced negatively to a small degree by the imports of thin particleboards from Canada. Doorskins for low-cost doors will continue to be an important part of the end use market although no precise estimate of the volumes utilized is available. Canada exports some of this.

Future Demand

The market will relate to the anticipated economic recovery and in particular, housing starts. From a 1981 consumption base of 1.9 million cum, the consensus is that the demand level in 1984 will be nearly 2.4 million cum, an increase of 26%. Siding panels will represent about 1.3 million cum, and non-siding 1.2 million cum of consumption at that time.

Forecasts of consumption in the year 1990 indicate that total demand for hardboard for all purposes will approach 3,200,000 cum, an increase of 77% over the 1982 level. This value implies that an increase in capacity or substantial imports will be required since the shortfall in present capacity would be about 900,000 cum. While some capacity increase may occur in dry process mills, imports from South America will probably be a major source of supply. In all probability, though, the increased demand will be largely supplied by thin particleboards, produced domestically or imported.

Summary

Assuming that the demand projection for the next ten years is realistic, it appears that perhaps only about 10% of U.S. demand will be supplied imported panels and these will be almost exclusively non-siding panels. This would indicate an imported volume of 320,000 - 500,000 cum annually by the year 1990. However, Canada now accounts for only 10% of U.S. imports, and these are panels with the lowest mill return value and most directly affected by production elsewhere. Therefore an optimistic view would be that Canada would export only about 50,000 cum annually assuming a continuing price competitiveness. In the judgment of CHI, this is unrealistic, especially in view of the potential for additional thin board (standard or MDF) which could be produced in Canada to expand our present exports to the U.S. These now compete with and are replacing standard hardboard. Therefore, we do not foresee a long term opportunity for Western Canadian hardboard in the U.S. market.

EEC

The potential for marketing hardboard in the EEC is severely limited by the production capacity within the EEC and in the surrounding countries, especially the Scandinavian, Poland and the U.S.S.R. In 1980 Europe, as a whole, produced about 3.2 million cum of hardboard while the U.S.S.R. contributed about 1.6 million in addition. The ready availability of hardboard within a very short distance to the market effectively eliminates Canada from major participation in the trade.

Southeast Asia

The consumption of fibreboards, excepting MDF which has been considered under the particleboard section, is not large in any Asian country, other than Japan. Korea, for example, operates one mill with 50% (12,500 cum) of shipments going to the domestic market. Taiwan imports a small volume to supplement its relatively low output. Hong Kong consumption is low and supply from existing sources such as New Zealand and Thailand is believed sufficient.

Hardboard production in Japan has shown little change over the past 10 years. FAO data indicate production of this panel averaged 280,000 cum over the period 1975-1980.

Singapore has no hardboard mills and supplies, totalling an estimated 4,300 cum based on 1981 data, are obtained entirely from Thailand, Brazil and the U.S. This is practically all consumed in the furniture industry.

Based on probable production costs of $180 per cum for Western Canadian poplar-based fibreboards, the chances of successfully competing with Asian and other sources in Southeast Asia are considered poor.

RIGID INSULATING BOARD (SOFTBOARD)

Regional Markets

Canada

The insulating board industry consists of 9 mills with a total installed capacity of 930,000 cum of which only 3, with a combined capacity of 170,000 cum, are in the west. Capacities vary widely as do the product lines. The estimated value of shipments in 1981 was about $35 million. Insulating board is produced in almost every developed country (see Appendix 4, Table 80, 81 and 82) and Canada is estimated to produce about 5% of the world's total supply. The structure and estimated annual capacity of the Canadian industry are listed in Table 52.

TABLE 52

CANADA
RIGID INSULATING BOARD
ESTIMATED CAPACITY, 1983

	Annual Capacity cum
Building Products Limited, Wabamun, Alberta	65,000
IKO Industries Ltd., Calgary, Alberta	65,000
Welclad Industries Ltd., Winnipeg, Manitoba	41,000
Nordfibre, North Bay, Ontario	142,000
Masonite Canada Ltd., Gatineau, Quebec	175,000
Canadian Gypsum Ltd., Louiseville, Quebec	140,000
Domtar Construction Materials Ltd., Donnacona, Quebec	120,000
Building Products Ltd., Pont Rouge, Quebec	170,000
Megantic Manufacturing Co. Ltd., Lac Megantic, Quebec	2,000
Total	930,000

The historical performance of the industry indicates that total production and domestic consumption are declining, while exports are maintaining a significant annual volume. Within the general product mix, two classes - natural or coated panels and asphalted sheathing are employed primarily as sheathing panels and these have, for the purpose of this report, been counted in the structural section. The two panels account for about 53% of total production of all softboards during the last 5 years.

Canadian production is currently less than 500,000 cum annually, of which 10% is exported. Imports are less than 5% of domestic shipments. The average annual consumption is about 500,000 cum for all types of panels. The three non-structural types of insulating boards are described below.

Roof Insulation Panels

The volume of domestic shipments of roof insulation panels has declined steadily by about 20% from 1970 - 1981. They now represent about 28%, or 140,000 cum, of all domestic softboard softboard shipments.

Roof insulation is produced primarily in 945 mm x 1890 mm panels. These are asphalt impregnated and are usually built-up at the job site to 7.6 cm to form an insulation medium on flat or slightly pitched roof decks.

In the roof insulation market, the wood-based panels face effective competition from glass-fibre panels and foam products such as polyurethane and polystyrene foams, patented cellular panels, panels made from expanded, low density volcanic material (perlite) and combinations of generically-different panels.

The size of the Canadian roofing market is difficult to establish. Consequently, the relative market shares of each of the competitive products can not be accurately defined.

The trend is to combine the wood-fibre panel with styrofoam to form a laminated panel which will eventually displace the all wood-fibre panels.

Acoustic Tiles and Panels and Other Decorative Board

The two categories, acoustic tiles and panels and other decorative board, which represent 25% of domestic softboard shipments, can be considered jointly since both are very similar. The consumer seldom distinguishes between them on the basis of acoustic properties and buys primarily on the basis of appearance. Tiles are usually 12.7 mm thick and made in various dimensions from 304 mm square to 608 mm square. Decorative panels also are made in plank forms. The major end-use is for suspended ceilings.

Consumption of these panels is directly related to housing and construction of commercial buildings. It appears that while new housing starts have sharply declined, the market for tiles, which are mainly imported, has increased due to the increase in DIY projects.

Other Panels

Backerboard panels are asphalt impregnated and used behind metal siding as an insulator but these are declining in importance due to competition from plastic foam. However, because of the increasing cost of metals and the corresponding reduction in dimension tolerances of metal siding, wood-fibre backerboard, is able to contribute some structural strength as well as insulating properties. Data on shipments and consumption of backerboard are not conclusive but the trend appears to be declining.

The remaining products in the "other" category are specialty items made to order, largely for original equipment manufacturers or other individual end-users. These products have individual requirements with respect to density, dimensions and chemical make-up.

Exports

Exports of insulating board, of all types, have consistently represented less than 10% of the production volume. The volume exported in 1981 was 49,201 cum valued at $5.5 million, while the indicated level for 1982 shows an increase. Transportation costs are the major constraint to the development of export markets which are primarily to the U.S., with small volumes of less than 300 cum each going to other such countries as the U.K., France, Australia, Netherlands and the West Indies, with no discernible regular pattern.

The U.S. tariff (see Appendix 7) permits duty-free access for insulating board. This has allowed some Canadian producers to establish ongoing markets in the U.S. within the radius of economically competitive transportation.

Access to overseas markets is hindered by freight rates. The cost of shipping a given surface measure of insulating board to an overseas market, for example, would be much greater than for the same volume of hardboard or plywood. The comparatively low density of the product, coupled with the relatively low value, limits the distance over which the product may be shipped and still remain competitive.

Imports

From 1970 onward, the insulating board industry has been faced with an increasing volume of imports, which rose from about 16,000 cum in 1970 to 81,271 cum in 1976 - a five fold increase in wood-based panels. By 1976, the imports of wood-fibre acoustic ceiling tile made up 37% of these imports and this trend has continued at an increasing rate to date so that acoustic tile now represents about 47% of the total wood-fibre insulating board imports. In addition to the wood-fibre type imports, Canada imports an additional volume of mineral based acoustic and ceiling tiles (mineral-fibre mixed with wood-fibre). Most of these originate in the U.S. and dominate the market.

Summary

The rigid insulating board industry provides an excellent outlet for poplar species, but Canadian production and consumption are in balance, while growth rates are very low or negative for each panel. Export markets are limited and imports of both wood-fibre and mineral tile panels are very high. Therefore, CHI does not foresee an opportunity for a new western Canadian producer or for significant expansion of capacity.

United States

The U.S. insulating board industry consists of 17 mills, of which 10 are in the south and south-eastern States, 2 in the northeast, 2 in Oregon and the other 3 in the mid-west. Capacity is estimated as 6.0 million cum annually, while consumption is stable at about 5.0 million cum.

From Table 53, it is seen that Canada both imports from and exports insulating board to the U.S., with the balance of trade in Canada's favour. There is a pronounced downward trend in U.S. consumption from 1976 onward, generally brought about by the need for better insulation materials and, lately, the general economic decline.

The average unit value of imports is estimated at US$62 per cum in 1980 and US$ 95 per cum in 1981. The unit values of exports in the same years are estimated at US$ 92 and US$ 113 per cum respectively.

TABLE 53 UNITED STATES RIGID INSULATING BOARD PRODUCTION AND CONSUMPTION

(thousand cum)

	Production	Imports	Exports
1970	4,424	136	70
1975	4,532	7	116
1980*	5,100	77	172
1981*	5,100	99	141

Source: FAO, U.S. Dept. of Commerce and interviews.

Notes: Canada is responsible for 99% of the imports and 90% of exports.
*CHI estimates.

The range of end-uses for insulating boards are the same as for Canada, i.e., roof insulation, acoustic and decorative tiles and general sheathing panels.

The uses for sheathing and insulation panels will probably be adversely affected by changes in the numerous Federal, State and local building codes. Foam materials are encroaching in the structural field.

In all probability, acoustic tiles and planks will hold their place in the U.S. market but the consensus is that new construction, repairs, etc., will consume only about 3.1 million cum by 1990, compared to 2.64 million cum in 1976, a growth rate of only about 1% annually.

Summary

CHI does not foresee any significant opportunity for additional poplar-based insulating boards emanating from B.C. or Alberta for the U.S. market.

EEC

Markets for rigid insulating board, other than those in North America are virtually non-existent for Canadian producers. The EEC consumes only token shipments fromm Canada because of the regional production which, although declining, is still much greater than Canada's. Landed costs of Canadian panels are considered a major factor in limiting large volumes of exports to the EEC from Canada.

Southeast Asia

There is a relatively small volume of insulating board and acoustic tile produced and consumed in Southeast Asia. Japan is the exception, with an average annual production of all types of softboards amounting to 290,000 cum for the period 1975 - 1980. Softboard consumption in Singapore is estimated at 12,000 cum annually, and this would probably be consumed in the construction industry. Brazil, followed by the U.S. and various other countries are the main suppliers. Trade sources in the region indicate that the chances of poplar-based insulating boards competing in the Southeast Asian markets are poor.

POPLAR PLYWOOD

Regional Markets

Canada

The general level of production and shipments of poplar plywood has been commented on previously in the structural panel section on page 58.

Table 54 lists the mills which produce poplar plywood and veneer. Some cut proplar veneer only but most cut both poplar and coniferous species and make plywood with various combinations of the veneers. The list covers the production of both construction grades and industrial grades of poplar plywood.

TABLE 54 CANADA

POPLAR PLYWOOD AND VENEER MILLS, 1982

Company	Location	Products
a) Plywood		
Cochrane Industries	Cochrane, Ont.	Poplar, Spruce
Levesque Plywood	Hearst, Ont.	Poplar
Normick-Perron	La Sarre, Que.	Poplar
Saskatchewan Forest Products	Hudson Bay, Sask.	Spruce (some poplar)
Temisply	Ville Marie, Que.	Poplar
Weldwood	Surrey, B.C.	Some poplar
Weldwood	Longlac, Ont.	Poplar, Spruce
Zeidler	Edmonton, Alberta	Some poplar
b) Veneer Only		
Tackama	Fort Nelson, B.C.	Poplar, Spruce
Zeidler	Mitsue, Alberta	Poplar, Spruce

As exhibited in Table 55 the annual production of non-structural poplar plywood, i.e., plywood generally bonded with an urea-formaldehyde adhesive and sold primarily to industrial manufacturers, has been declining over the last few years.

TABLE 55

CANADA

POPLAR PLYWOOD, INTERIOR TYPE

PRODUCTION AND SHIPMENTS

(cum)

	Production	Shipments		
		Domestic	Exports	Total
1960	74,000	72,374	-	72,374
1965	66,000	57,990	6,440	64,430
1970	55,000	47,657	5,300	52,957
1975	62,000	51,470	9,100	60,570
1980	39,000	29,520	7,380	36,900
1981	35,000	25,200	6,300	31,500
1982*	27,000	20,800	5,200	26,000

Source: Statistics Canada. CHI notes and interviews.

*Based on data to July 31, 1982.

The industrial grades range from 6.35 mm to 25.4 mm in thickness and are often cut-to-size. The bulk of production is sanded, and grades include highly selected 'A' face, down to an industrial grade, almost equivalent to a sheathing grade. Generally, the panel contains wooden or plastic patches to provide a smooth surface for further manufacturing, including over-veneering. Coniferous cores are employed to increase panel stiffness and stability.

Markets for poplar plywood are found in the kitchen cabinet, millwork, toy, electronic games, pinball machine, cable reel, crating, packaging, general millwork and construction industries. Carpet nailing strips are almost always made of poplar.

Particleboard and MDF have eroded the market for many of the above uses, especially for over-veneering applications. It is doubtful whether poplar plywood will survive its current decline, especially in view of production costs. However, for those uses where a very stable surface is required, poplar plywood with a spruce core will always be in demand.

An indeterminate volume of industrial grades is exported to the northeastern U.S. by the Ontario and Quebec producers, primarily to manufacturers of millwork and other specialties.

Poplar Veneer

There is only one mill in northern British Columbia which produces poplar veneer for sale, as veneer, on the open market. One other mill, specializing in hardwood plywood production, as well as coniferous plywood, cuts poplar and cottonwood veneer from the Fraser Valley region for incorporation into some of its hardwood plywood panels. The two Alberta mills which have access to poplar are now, to all intents and purposes, out of the poplar business and are concentrating on spruce plywood.

The poplar veneer market is very small, compared to that of softwood veneer. Most of the B.C.production is sold to the plywood mills in Washington and Oregon where it is used in both softwood and hardwood plywood. Pricing is always much below that of Douglas-fir and spruce veneers.

Future Demand

The demand for poplar veneer in the domestic market has declined because of the shift in sheathing type panels to waferboard and the general lack of high quality poplar peeler logs in B.C. or Alberta.

At the same time, the quality veneer of poplar and the average thickness generally produced do not blend in with veneers typically used in plywood or furniture manufacture in either Europe or Southeast Asia. These markets generally require very thin, smooth, knot free veneers with a high proportion of wide components. The opportunity for overseas exports of poplar veneer is, therefore, considered virtually non-existent.

Conceivably, a complex in which only the best portion of the best log was cut into veneer, with the balance sawn or converted to re-constituted wood panels or pulp chips would be a technically sound operation. However, the economics, are questionalbe and would have to be determined by a specific study.

A comparison of the prices of poplar plywood and industrial particleboard shows the competitive position in favour of the latter. However, for those consumers requiring a high grade substrate panel, the price differential is of less importance than quality.

TABLE 56 COMPARISON OF DISTRIBUTION PRICES
EASTERN CANADIAN PANELS *
($ per cum)

Thickness	Industrial Particleboard Grade		Poplar Plywood Grade	
	Industrial	Underlayment	Industrial	B/BB
15.9 mm	224	190	436	464
19.0 mm	223	190	405	430

*Delivered in Ontario and specified points in Quebec, 1982. Prices before discounts, Federal sales tax not included.

United States

The poplar plywood industry in the U.S. is concentrated in the Lake States region, based on P. tremuloides (trembling aspen) and P. deltoides (eastern cottonwood).

Aspen plywood, also called "popple", is produced in the area defined above by a number of relatively small mills which collectively ship much less plywood than the mills in Canada. Two larger, mixed hardwood mills include some aspen in their product mix. Uses of aspen plywood are generally the same as in Canada, i.e., for core panels, pallets, crating, low priced furniture and industrial panels of various types. Markets are found throughout Wisconsin, Michigan, Illinois, etc., in which areas Canadian poplar plywood also competes. The industry's output and markets are declining because of the impact of the various composite panels. As shown in Table 54, Canadian exports to the U.S. are very small and are declining in phase with U.S. aspen plywood production.

Other Markets

Canada has been singularly unsuccessful in exporting poplar plywood overseas. Some has been shipped to the U.K. on an intermittent basis, but the production of beech, poplar plywood and particleboard in countries such as Germany, France and, especially, Italy limits any long-term prospects for western Canada. Italian poplar plywood, used extensively in furniture and crating for automobile and machinery parts, is based, to a large extent, on poplar plantations concentrated in the Po Valley in Northern Italy and logs imported from Yugoslavia and other European sources. In Southeast Asia, various hardwood plywoods, made from local species, are available at prices well below that of Canadian poplar, and effectively block Canadian export opportunities.

Summary

The poplar plywood industry has declined in importance in both structural and non-structural uses. Waferboard and the particleboards are encroaching on all but the most specialized markets. As evidenced by the low production record in B.C. and Alberta, there seems to be no significant opportunity for expansion of capacity for western poplar plywood.

LAMINATED VENEER LUMBER (LVL)

Laminated veneer lumber represents a product which is a cross between plywood and lumber.

The basic unit of the product is veneer, up to about 6.4 mm thick which, after drying, is pressed, with all laminations parallel in the grain direction, into a multi-layered panel of a thickness range up to 76 mm. The large panels are then ripped to produce laminated lumber of appropriate widths. The product exhibits excellent dimensional stability and strength properties.

There is no commercial production of LVL in Canada, but experimental production of poplar-based LVL for studs has indicated the technical qualities were satisfactory. The relative selling prices of poplar LVL studs and standard coniferous studs have not been effectively established.

There is a small plant in Finland, which produces structural lumber by the LVL method, combining pine and poplar. Reports indicate a very lengthy and costly development program was required to bring the concept to the production stage.

LVL is also produced in the U.S., utilizing oak, to make parallel laminated panels for the furniture industry on a captive market basis.

Summary

There is insufficient data to form a clear opinion as to the opportunity for LVL made from western Canadian poplar. The price would be above that for sawn lumber studs or other equivalent sizes and the long term physical and design properties are not yet established.

BLOCKBOARD

Blockboard is a core material produced by gluing numerous pieces of sawn lumber of equal cross section and, of varying lengths, in parallel to produce a panel suitable for over-veneering. The individual component pieces average about 19 mm x 19 mm in cross-section in lengths up to 1 metre.

The panel is employed in high quality furniture and millwork as a core panel which is overlaid with the higher quality veneers. It is widely employed in Europe and Asia, used to a lesser degree in the U.S. and to a limited degree in Canada.

The market is now dominated by blockboard produced in Southeast Asia from offcuts of the primary sawmill industry. Species employed are meranti, ramin, lauan, etc. The panels are overlaid before export to the U.S. and Europe, or may be shipped as a core board. Canadian millwork and cabinet plants import the core board although definitive market information is not available. There is, in addition, a large volume produced in Europe as a by-product of the hardwood sawmill industry.

The imported panels are cost competitive with Canadian poplar blockboard panels due to the lower recovery factors in the poplar, together with higher costs of production. Most importantly, dimensional stability is better.

Summary

Because of the limited market and competition from the imported panels and encroachment in this market by MDF, it is considered that blockboard is a poor prospect for increasing the utilization of poplar.

Distribution Mechanics - All Panels

The distribution system for poplar-based and other panels made in Canada follows closely the system by which lumber is moved, i.e., from producer to end user in several well-defined stages.The mechanics are described on page 29 of this volume and are, therefore, not repeated in detail here.

Transportation Considerations - All Panels

Canada and the United States

Panel products made in the western provinces face an appreciable disadvantage in the delivered cost to the major eastern Canadian and U.S. markets due to differences in freight costs, especially by rail. The effect of these costs from probable and existing shipping centres in the east and west to major markets is shown in the table below.

TABLE 57 ESTIMATED RAIL TRANSPORTATION RATES

January 1983

($ per 100#)

From:	To: Toronto Ont.	Montreal Que.	Winnipeg Man.	Houston Tex.	Los Angeles Calif.	Chicago Ill.
Mitsue, Alta.	4.48	4.48	2.13	5.57	3.61	4.71
High Prairie, Alta.	4.48	4.48	2.2	5.37	3.61	4.71
Hinton, Alta.	4.48	4.48	2.09	5.54	3.12	4.58
Rocky Mtn. House, Alta.	4.48	4.48	2.18	5.54	3.47	4.58
Vancouver, B.C.	4.25	4.25	3.32	4.17	2.52	4.21
Longlac, Ont.	1.30	1.60	1.90			
Val d' Or, Quebec	1.25	0.95	2.10			
Bemidji, Minn.	n/a	n/a	n/a	4.20	4.31	n/a

From:	To: Vancouver	Portland	Phoenix	Los Angeles	San Francisco
Prince George, B.C.	1.61	3.30	5.11	4.42	4.20

The rates may be used as a guide but, in fact, many shipments are now made on the basis of a fixed cost per car. In this case, a car may be loaded to its full rated capacity which may be 170,000 lbs. while the rate is calculated on the basis of a 120,000 lb. rate. This is particularly effective for panels such as waferboard and particleboard, where densities are in the range of 42 to 50 lbs. per cubic foot.

Translated into costs per unit of sale, i.e., dollar value per cum, the effect of transportation costs is significant for both waferboard and particleboard when calculating delivered prices. Table 58 illustrates the probable transportation costs, assuming the panels were made in the locations shown for B.C. and Alberta.

TABLE 58 TRANSPORTATION CHARGES WAFERBOARD AND PARTICLEBOARD

(C$ per cum)

	Destination							
	Montreal		Vancouver		Chicago		Los Angeles	
From	WB	PB	WB	PB	WB	PB	WB	PB
Mitsue, Alta.	66.39	71.14	32.01	34.30	83.73	89.72	64.20	88.80
Rocky Mtn. House, Alta.	66.39	71.14	27.71	29.70	81.46	87.28	61.72	66.12
Vancouver, B.C.	62.99	67.49	-	-	74.87	80.22	44.82	48.02
Bemidji, Minn.	n/a	-	n/a	-	n/a	-	63.87	-

WB - Waferboard PB - Particleboard

A quick inspection of the table illustrates the differential of $3.23 per 100 lbs. which exists between most northern Alberta points and the Val d'Or region of Quebec when shipments are made to Toronto. This would amount to about $48.00 per cum for waferboard or particleboard shipped from either region. When this is compared to the current average mill selling price of waferboard at $120 per cum, the effect on competitive pricing from the west is serious. When the central Canadian market, e.g., Winnipeg, is considered, it is seen that transportation costs are about equal from the west or east.

To overcome these differentials, most producers rely on highway transportation which generally can be negotiated relatively freely. Loads are generally smaller but flexibility in scheduling and the door-to-door nature of the service are important positive factors.

Sample rates for truck transportation are shown below as a general guide. Certain eastern panel mills operate their own trucks which gives them a significant added advantage over the rates listed.

TABLE 59 ESTIMATED HIGHWAY TRANSPORTATION RATES

(January, 1983)

($ per 100 lbs. - 44,000 lb. minimum)

	To		
	Winnipeg	Toronto	Montreal
Vancouver, B.C.	3.69	4.13	4.13
Fort St. John, B.C.	4.18	4.25	4.55
Edmonton, Alta.	1.41	3.08	3.99
Longlac, Ontario	1.98	1.24	1.70
Val d'Or, Quebec	2.10	1.12	0.92

The differential between eastern and western mills is still significant, being of the order of $28.00 per cum, comparing Edmonton and Val d'Or to Toronto.

The same picture emerges when the rates to major U.S. market regions are reviewed. Based on the rate factors, the south and southwest regions of the central U.S. emerge as the market area where B.C. or Alberta panels could be marketed. Other factors such as competing panels from Washington, Idaho, Oregon and California exclude any real chance, however, except for waferboard which is not yet produced in the region.

Overseas

At the present time, the transportation charges for export shipments to the EEC and Southeast Asia are highly variable. Shipping agents were reluctant to quote their charges based on hypothetical shipments, such as in the case for poplar panel mills in the west. Estimates ranged about C$60 to C$70 per tonne, subject to additional charges for bunker oil, whether or not containers were to be used, frequency and volume of shipments, etc. Generally, it is assumed that for some time to come, shipments would not individually exceed 500-1000 tonnes each. For purposes of the study, CHI has assumed C $75/tonne would be a reasonable estimate and this would include customs documentation and related port charges. This cost has been used to estimate delivered prices of the various panels to potential markets overseas using Vancouver as the shipping port. The effect of a mill location somewhere within the two provinces has been ignored at this time.

Price Considerations - All Panels

This section summarizes the prices for the major panels of significance to poplar-based products.

Waferboard

In comparing the price received by the mill ("mill net price"), the most striking difference is that between construction plywood, sheathing grade and waferboard. Since its original penetration of the market place, waferboard has been priced 10 to 20% below sheathing grade plywood. This occurred due to the lower costs of production of waferboard and the necessity for waferboard to become established in the market.

TABLE 60 MILL NET PRICE, WAFERBOARD

Year	Average Mill Net Price $per cum
1976	130
1977	139
1978	161
1979	167
1980	139
1981	156
1982	133

Source: Statistics Canada. Includes export sales.

Published price lists show a substantially higher price range than in the table but, in fact, very large discounts are given to distributors. The current 1982, net mill price does not cover all costs of production.

For the year 1982 the wholesale price of 11.1 mm thick waferboard in Chicago ranged from US$146 per cum, fob to $175 per cum, fob with an average of $163.00 per cum or about C$200.00 per cum. It is estimated that waferboard made in B.C. or Alberta would cost at least C$245 to deliver to that market, including freight and duty, but not allowing a profit margin.

The estimated wholesale delivered cost (11.1 mm) in San Francisco, Los Angeles and Phoenix areas is US$209 or C$250 per cum from which discounts are in effect. The equivalent panels probably can be delivered from Northern Alberta including U.S. duty, for about C$190 per cum before allowance for mill profit margin.

The data presented relative to probable demand for structural panels indicates strongly that, for western poplar species, the only immediately attainable markets are for waferboard.

The geographic locations of existing and future waferboard mills indicate that for almost all North American markets there is likely to be an ample supply of the panel made between western Canadian sources and the major consuming areas. When the delivered prices from the various sources of supply to the markets are compared, it is seen that western Canada's marketing opportunity is limited and probably exists only in the Western U.S.

Particleboard

Table 61 shows the average net mill sales return for particleboard plants in Canada for the years 1976 - 1982.

TABLE 61 MILL NET PRICE, PARTICLEBOARD

Year	Average Mill Net Price $/cum
1976	88
1977	101
1978	124
1979	125
1980	147
1981	169
1982	164

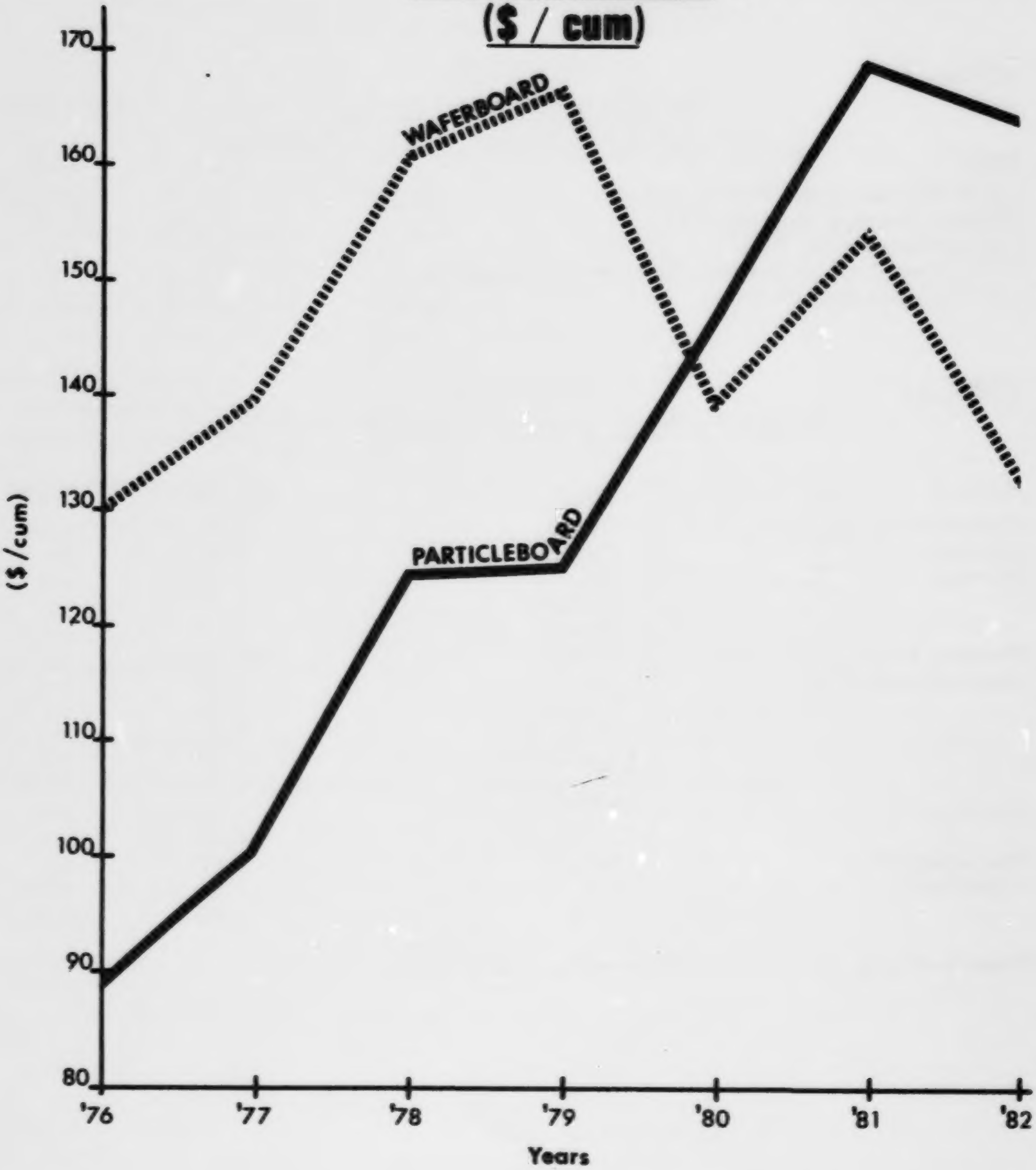
Source: Statistics Canada. Includes thin particleboard and exports.

The average delivered cost of particleboard in July 1982, including all grades, in the Toronto market area from the U.S. western region, was about C$277 per cum, inclusive of freight, duty and exchange. For the same mix of industrial particleboard made in Ontario, the delivered wholesale price, including freight, but excluding Federal sales tax, is C$240 per cum. Discounts of up to 30% of the delivered price have been in effect from time to time during the last few months. It is unlikely, barring an unforeseen major change in relative costs of production in either country, that the relative price position will change. The added advantage of a short haulage distance from the mills in eastern Canada to the major markets will continue to give an edge to domestic production. The average price for western made particleboard is estimated at $120 per cum fob mill. This would be appreciably higher if poplar roundwood was the basic raw material.

Thin particleboard, which can be delivered at a cost of about $140 per cum in Vancouver, below the cost of imported hardboard, shows a potential for further market development both in western Canada and the Pacific Northwest.

The trend in the average mill net price for waferboard and particleboard in Canada is shown in Figure 12.

FIGURE 12
CANADA
MILL NET PRICES
($ / cum)



Overseas Prices

To provide perspective, a summary of prices prevailing in 1982 in the major overseas markets is presented in Tables 62 to 67. The tables are derived from statistical reports, trade publications and discussions held in the various countries. It may be noted that the officially published prices are subject to considerable discounts which fluctuate widely in response to the market conditions.

TABLE 62

SINGAPORE

PRICES FOR SELECTED PANELS

Item	Value C$	Unit
Lauan Plywood, plain, 9 mm	148.00	cum
Plywood, average imported (cif)	316.00	cum
Particleboard, plain, 9mm	173.00	cum
Particleboard, plain, less than 9mm, average imported	175.00	cum
Particleboard, plain, 9-15mm	212.00	cum

TABLE 63

HONG KONG

ESTIMATED PRICE OF IMPORTED WOOD MATERIAL

Material	Source	Value C$	Unit*
Cottonwood Logs	Canada	75.00	cum
Veneers	Canada	1.40	sm
Plywood	U.S.	7.40	sm
	Canada	3.30	sm
	Taiwan	1.70	sm
Plywood, Lauan, Conc. Form	various	288.00	cum
Reconstituted Wood	U.S.	3.40	sm
	Canada	7.30	sm
	Thailand	7.40	sm
	Australia	5.50	sm
	New Zealand	4.00	sm
Hardboard	Brazil	1.45	sm
	Australia	1.80	sm
Insulating Board	Brazil	1.40	sm
Fibreboards, misc.	U.S.	1.80	cum
	Italy	1.55	cum

*These statistics did not define thickness basis in all cases.

Local prices for construction material on the job site as reported by the Hong Kong Trade Department, April 1982, were:

	Value C$	Unit
Hardwood plywood, 19 mm	366.00	cum
Hardwood planks, 25.4mm	132.00	cum
Hardwood "columns", 50mm x 75mm	135.00	cum

TABLE 64

JAPAN

ESTIMATED PRICE OF IMPORTED WOOD MATERIAL

Material	Source	Value C$	Unit
Logs,poplar, cottonwood	U.S.S.R.	45	cum
	Canada	85	cum
	U.S.*	125	cum
Plywood, T & G**	Sweden	26	sm
	Canada	5	sm
	U.S.	10	sm
Plywood, grooved, prefinished or overlaid	Canada	6	sm
	U.S.	6	sm
Plywood, coniferous	Canada	12	sm
	U.S.	5	sm
Reconstituted wood	South Korea	207	cum
	Taiwan	211	cum
	Sweden	301	cum
	Canada	338	cum
	U.S.	232	cum
	Australia	236	cum
	New Zealand	229	cum
Laminated Lumber	Finland	538	cum

*May be yellow poplar species.

**Species, thicknesses and grades are not always identified for plywoods.

TABLE 65 KOREA
ESTIMATED PRICE OF IMPORTED WOOD MATERIAL

Material	Source	Value C$	Unit
Plywood, over 19.5 mm	Japan	170	cum
Plywood/Chipboard over 19.5 mm	New Zealand	260	cum

TABLE 66 TAIWAN
ESTIMATED PRICE OF IMPORTED WOOD-BASED PANELS

Material	Source	Value C$	Unit
MDF	New Zealand	300	cum
Particleboard	New Zealand (1981)	225	cum
Particleboard	U.S. (1981)	240	cum
Particleboard	All sources, ave. (1982)	260	cum

TABLE 67 EEC
ESTIMATED PARTICLEBOARD PRICES, 1982

Source	Value C$	Unit
Romania	$ 101	cum
Spain	136	cum
Belgium	200	cum
Finland	150	cum
West Germany	300	cum
Canada	180	cum

Table 67 indicates the price factors which affect potential shipments of particleboard and MDF from Canada to the EEC.

On average, MDF is priced 50 to 60% above particleboard in the EEC so that the average value in 1982 would be about C$300 to 350. This ratio is about the same for all countries, although some show a difference of 100%.

To provide some perspective for the foregoing price array, an estimate of current manufacturing costs for the family of panels is shown in Table 68. The costs are based on the use of by-product material for all panels, except plywood and waferboard.

TABLE 68 CANADA
ESTIMATED COST OF PRODUCTION FOR VARIOUS WOOD-BASED PANELS
(1983)

	Cost $per cum
Coniferous Plywood, Sheathing	185
Waferboard	135
Industrial Particleboard (Thick Panel)	120
Thinboard Particleboard (Specialized Mill)	135
MDF	160
Hardboard (Wet Process)	170
Comply	150

Source: CHI estimates.

It is with the preceding costs as a guide that any potential market for poplar panels must be evaluated. The use of poplar roundwood would increase these prices, except for waferboard, and when added to the cost of transportation and others such as tariffs, exchange, etc. to overseas markets would appear to make penetration of any overseas market a difficult task.

Trade Inhibitors - All Panels

Building code acceptance and tariffs are considered to be the major inhibitors in export markets for waferboard and particleboard.

United States

Acceptance by the many code authorities in the U.S. is a time consuming, yet a vital step in penetrating the U.S. market for waferboard. U.S. tariffs are being reduced in stages to a level of 4% by 1987. While this is a relatively low tariff, it will have some influence on the competitive position of waferboard since, at that time, U.S. production will be much greater than at present and will greatly exceed that of Canada. The same general effect applies to particleboard, although the somewhat lower wood cost in Canada offsets the tariff effect. U.S. building codes are restrictive with respect to emission of formaldehyde fumes from adhesives, especially in particleboard.

The EEC building codes are very restrictive concerning waferboard and require a much greater degree of technical assessment than in North America. In addition, the tariffs will not be less than 10% over the next few years, which puts waferboard at a considerable disadvantage compared to coniferous plywoods.

In Japan, the major inhibitors are the Japanese standards, inspection services and building agencies. The tariff is scheduled to be no less than 12% under the GATT agreement, which is a formidable obstacle, although lower than the plywood rate fixed at 15%. The inspection of plywood imported into Japan is very rigid and, presumably, other imported panel products would be treated the same way.

Korea and Taiwan have extremely high tariffs on panels at 30% and 40%, respectively. Entry probably would have to be through a "duty draw back" system or, in the case of Taiwan, through a purchaser located in an industrial free zone.

Particleboard and waferboard tariffs are the same for all of the above countries, excepting Korea, and will be reduced under the GATT. Except for the unlikely use of Canadian particleboard as a structural material, the building codes do not apply, although the specific country standards for the panel properties would have to be met for industrial consumption.

Future Demand - All Panels

There are apparent market opportunities for poplar-based panels made in western Canada with varying chances of success.

For each of the panels a strong growth trend is predicted up to the year 1990. Softwood plywood, which is essentially a North American industry shows an average annual increase from 1980 of 1.7%. Approximately the same annual rate applies to all panels except particleboard for which the annual rate is 4.3% from 1980 - 1990. MDF and waferboard are counted in the particleboard class.

It is very clear that the composite panels are, more and more, becoming the major elements of the world's panel industries. The demand for particleboard and MDF on a world scale is, probably, a greater proportion of the total for composite panels than the demand for waferboard. Western Canadian poplar species will, if production economics are favourable, be able to participate in the general development along the lines suggested by the data. Possible developments are suggested in the following sections.

SRI, Menlo Park, California has forecast probable world trends in production of wood-based panels. In our judgement, the SRI values may be taken as a reasonable basis of estimate. The trend is shown in Table 69.

TABLE 69 WORLD
PROBABLE PRODUCTION OF WOOD-BASED PANELS

(thousand cum)

	1970	1980	1990	Increase From 1980 %
Softwood Plywood	15,329	18,518	21,587	17.0
Hardwood Plywood	18,469	21,738	25,668	18.0
Total Plywood	33,798	40,256	47,255	17.0
Particleboards	19,163	40,632	57,990	43.0
Hardboard	5,971	n/a	11,280	n/a
Insulating Board	7,355	7,300	8,605	18.0
Total	66,287	88,000+	125,130	

United States

The U.S. has a great supply of hardwood timber which could be converted to either structural or non-structural panels if the economics are favourable. This poses a serious threat to additional Canadian exports to the U.S. Generally, in the west, there is more opportunity for Canadian made structural panels based on the poplar resource. However, a new facility should not be considered until the present capacity in Alberta is practically fully utilized. Waferboard, including OSB, offers the best chance.

In the non-structural sector, thin particleboard probably can be sold to the northern region of the western States to a greater degree than at present, assuming the cost of poplar furnish is competitive with that of coniferous material.

The other poplar-based panels, such as plywood, insulating board and hardboard, offer no additional opportunity in U.S. markets.

Southeast Asia

In Southeast Asia, the problems associated with timber supplies are serious and will cause restructuring in the wood-based panel industries. This is apparent in all countries which have to date relied upon imported lauan species for plywood which, in turn, has been exported to all countries, especially Canada.

The furniture and secondary manufacturing industries in Korea, Taiwan, Hong Kong and Singapore increasingly are using imported panels such as particleboard and MDF, often imported from the western U.S., Australia, New Zealand and Europe. This indicates opportunities for western Canada which are detailed below.

The structural panel industries in Southeast Asia, especially Japan, are still well supplied with Asian produced hardwood plywoods for concrete forms and general construction, etc.

Since timber and land values are high, the demand for housing will be supplied by apartments and high rise structures. These are not large consumers of panels except for the site work which accompanies the construction phase. This makes the opportunity for waferboard only marginal in the area, with Japan, perhaps, the country with the best potential.

Europe

The European continent, in particular the EEC, still is a major producer of wood-based panels, although it will experience future raw material problems. Imports from all sources, including the U.S.S.R. and eastern Europe, will be major sources of particleboard for a considerable time. Waferboard has not made significant progress in the face of delivered costs of coniferous plywood from Canada and the U.S. Technical objections by building authorities are still serious obstacles.

There is probably no real opportunity for other panels with the exception of MDF. This opportunity is explained in the following section.

Canada

Waferboard capacity is more than adequate for present and future markets, including exports to the U.S. Any plan to expand waferboard capacity, based on western poplar, will have to include a well defined, additional export market.

Poplar plywood in Canada shows no appreciable need for additional capacity and offers no additional chance for B.C. or Alberta.

Particleboards and MDF, when the Canadian domestic market and exports are considered, do offer possibilities. Additional particleboard and MDF can be sold within Canada. Export markets include the northern and western states for thinboard; the EEC for MDF; and Japan, Hong Kong, Taiwan, Singapore, Korea for indeterminate volumes of particleboard sales, but with MDF probably showing the best chance.

As noted, all MDF now consumed in Canada is imported from the western U.S. It must be repeated, however, that the production economics of particleboard and MDF are questionable when the cost of direct logging for the express purpose of supplying the mills must be absorbed. Since, at this time, there is no large converting unit utilizing poplar species and developing large volumes of useable by-products in western Canada, any move towards developing the industrial panels must consider coniferous furnish as the major supply base. A concept along the following lines is suggested.

Opportunities for Western Canadian Panels

1. Medium-Density Fibreboard

Table 70 shows the estimated volume of MDF consumed in countries within the trading zone emanating from Vancouver. Some or all of this might be replaced from Canadian production if delivered costs were reasonable. Subject to a more detailed study, CHI estimates, for conceptual purposes, that 70% of the Canadian consumption and 40% of the balance in the EEC and Southeast Asian region might be marketed from a western mill. The volume would total about 100,000 cum annually, which requires a large capacity MDF mill.

TABLE 70

ESTIMATED VOLUME OF MDF
MARKET POTENTIAL FOR WESTERN CANADA
1983

Market	Present Source	Apparent Consumption (cum)
Canada	Oregon, Montana	50,000
UK/EEC	U.S. - Shipped via Vancouver	15,000
Japan	U.S.) New Zealand) Australia)	50,000
	Domestic	n/a
Korea	New Zealand	n/a
Hong Kong	New Zealand Yugoslavia	15,000
Taiwan	Imports Domestic	73,000
Singapore	Imports	15,000
Approximate Total Consumption		218,000

One of the key cost elements is wood supply which should be obtained, preferably, from by-product material. Technically, any species can be utilized in the form of sawmill waste, chips, slabs, planer shavings, plywood mill trim, small roundwood, log trim ends or logs (pulpwood grade or less). The key factor is the delivered cost of the furnish to the refining operation. Mixtures may be employed, under control, to maintain furnish quality and reduce overall wood costs.

Poplar species qualify under the above conditions but, since there is only a very small volume available in the form of waste, the economics are questionable if the logging of poplar roundwood is the only source of supply.

It is essential to develop a supply of waste from a conversion plant which could then absorb a substantial portion of the cost of logging in its primary manufacture and divert some of the lower quality logs and any waste generated to the MDF mill.

2. Particleboard

There appears to be a further opportunity to market thin particleboard in Southeast Asia. While standard particleboard perhaps could also be exported, it is considered, at this time, a better prospect to develop the MDF concept for thick panels since it services the same general markets and offers several advantages to the consumer which offset the higher costs over particleboard. The markets for thinboard would be western Canada, the northern region of the U.S., adjacent to B.C. and Alberta, and, possibly Southeast Asia.

Conclusions and Recommendations - All Panels

There are promising markets for certain panel products for which the poplar group is technically suitable. However, a critical factor is the cost of wood. In this respect, the use of poplar in roundwood form, delivered specifically for the panel manufacture, is questionable, except for manufacture of waferboard. The logging cost would be at least equivalent to that of coniferous species while the recovery factor would be less than coniferous.

If poplar is to be used, it should be supplied as a by-product of another operation, of a significant size, such as a pulpmill or sawmill, to obtain favourable economics. This implies a complex in which a large portion of the logging cost is absorbed by the primary products.

The panels with the most potential for development in the two western provinces are MDF and thin particleboard but, unless the concept of a poplar-based complex is established, the raw material for these should be by-products of a coniferous operation, e.g., planer shavings.

Next in order of market potential, and following the same principles as above, would be standard particleboard. Priority should be given to these three panels in near-term planning.

Waferboard and OSB capacity appears more than adequate in western Canada in the near term so that, while offering a technically feasible opportunity for poplar utilization in roundwood form, these should be given a lower priority for development. A factor to be considered is the ongoing effort to convert portions of the immense reserves of low grade cedar in B.C. into structural panels. Cedar sawmill by-products are, of course, used at this time for production of standard particleboard in Vancouver.

The other panels such as poplar plywood, hardboard, rigid insulating board, Comply and LVL do not appear to offer significant market opportunities for some time, if at all, for large scale utilization of poplar in the west.

ENERGY

Introduction

Production of energy in various forms from a forest resource is undoubtedly one of the oldest methods of wood fibre utilization. Over the past decade, sharply escalating world energy demand and world prices for oil (the principal source of energy) have generated intensive research into developing more efficient oil-dependent heating methods, in energy conservation measures, and in developing alternate sources of energy. Among these alternatives are solar, tidal, geo-thermal, nuclear, agricultural and forest biomass.

This section of the report presents a discussion of the use of wood fibre for the production of energy. The decomposition of wood can produce many forms of energy, as discussed in the section on chemicals, but, to date, only energy in the form of electrical power has been sold successfully by forest product companies. This discussion, therefore, is directed specifically to the sale of electrical power generated through the use of forest biomass and/or residue from a wood processing operation.

A discussion of power marketing necessarily involves a discussion of the technical and economic aspects of power generation/distribution since the marketability of power is directly dependent on technical/economic factors. To the degree possible, however, technical details have been kept to a minimum, with a definition of technical terms included in Appendix I. Two terms which occur frequently and which are, within the electrical industry, standard units of measurement, are kilo-watt hours (kWh) and megawatts (mW). kWh provides a measure of energy consumption and mW a measure of energy capacity or size.

Sources of information included power generation studies carried out in both Canada and the U.S., discussions with officials of B.C., Alberta, California, Washington, Oregon and Montana Public Utilities, national and international statistical data, and CHI's files and records.

A summary of residue-based energy production is presented first and this is followed by discussions of regional and end-use markets for power. A review of some of the technical/economic constraints is then presented and this, in turn, is followed by a discussion of power pricing and probable trends.

Product Selection

Until the early 1970's, residue generated in either logging or log processing, was regarded primarily as a waste disposal problem. Relatively minor quantities were used beneficially in the production of usable energy but most was burned without recovery of the heat produced. The remainder was used for purposes such as landfill. Over the past decade or so, however, wood residue has been recognized as a valuable resource and substantial research and development programs have been funded with the objective of developing means for efficient utilization of this resource. To date, these programs have resulted primarily in the introduction of systems which convert wood residue into heat for use either directly as a hot gas or in the form of steam. These forms of energy have been used almost exclusively as process energy, i.e., used in a manufacturing process.

Recently, however, this traditional use has been modified or extended to permit the generation of electricity in addition to the production of process heat.

Although a generating plant, designed for wood-based fuel and operated to produce only electrical power for sale to a public utility system would be possible technically, in practical terms, the concept would be unacceptable. The only market available would be the utility company in the particular region. The amount of power which such a single product plant could generate would be negligible in relation to the utility's total requirements. Consequently, it would receive a low priority and would be very vulnerable in periods of low demand. In other words, the single market available to the plant could not be depended on to maintain a consistent, stable demand. For this, and other reasons, the discussion presented in this section relates only to co-generated power, i.e., power generated as a by-product of process steam. It should be noted that, although there are a number of co-generation plants operating on forest biomass and providing power to public utilities in many world areas, there are, at present, no generating plants based on biomass only supplying power as a single product. A multi-product complex producing several wood-based products and electrical energy from residues or from a surplus of self-generated process steam might be less vulnerable to fluctuations in demand from the utility.

Regional Markets

Power generated in either B.C. or Alberta may be sold only to the appropriate provincial utilities which, in effect, represent the sole market for co-generated power. Since the receptivity of these utilities to the purchase of private power would be heavily influenced by overall electrical demand trends, a brief review of these trends is of interest to this study. Table 71 shows consumption trends in North America, which is the only market available for power generated anywhere in Canada. For comparison, however, trends in western Europe are also shown.

TABLE 71 ELECTRICITY CONSUMPTION - EUROPE AND NORTH AMERICA

(kWh X 10^9)

Source	1975			1979		
	U.S.	Canada	Europe	U.S.	Canada	Europe
Hydro	306	204	375	286	236	442
Nuclear	184	13	111	271	32	177
Thermal	1,693	63	932	1,875	77	1,102
Geo-Thermal	3	-	3	5	-	3
Total	2,186	280	1,421	2,437	345	1,724

Source: International Energy Agency - Paris 1982.

The increasing demand for all forms of energy is clearly evident. In Canada and the U.S., overall demand increased at an average rate of 5.3 and 2.8% per annum respectively over the period shown. Demand in Europe increased at a rate similar to that experienced in Canada, i.e., approximately 5.0% per annum. Increases in demand have occurred in all world regions, industrialized and non-industrialized, although the rate in the industrialized countries has been generally much higher than in the developing areas. For Canada, increased demand was satisfied primarily through additional generation of nuclear power which increased at the very high rate of 25% per annum.

Of the total electrical power consumed in Canada in 1979, Alberta and B.C. accounted for 5.9% and 12.6% respectively, and these percentages are not likely to change significantly in the forseeable future.

As already noted, the sole potential markets for power generated by any means in either Alberta or B.C. are the provincial utility companies. In B.C., this means B.C. Hydro and Power Authority (BCH), the only licensed public utility in the province. There are, however, three utility companies in Alberta: Alberta Power Limited (APL), Transalta Utilities Corporation (TUC) and Edmonton City Power. Only the first two companies are of any interest to this study since Edmonton City Power is restricted to servicing the city of Edmonton.

Details of the operations of the three applicable utilities are contained in Appendix 7, but for convenience a brief summary of key data is presented in Table 72. Appendix 7 also includes an outline of the existing power production and transmission systems for B.C. and Alberta.

TABLE 72 INSTALLED CAPACITY AND PEAK DEMAND EXPERIENCED BY BRITISH COLUMBIA AND ALBERTA POWER UTILITIES

(mW)

Item	B.C. Hydro	Alberta Power	Transalta
System Capacity:			
Hydro	7,491	2	800
Thermal	1,347	1,055	2,556
Total	8,838	1,057	3,356
Peak Demand	5,902	652	2,755
Peak % of Capacity	67%	62%	82%

Source: Provincial Public Utility Companies

Alberta's heavy dependence on thermal (coal and natural gas) generation relative to that of B.C. is clearly shown. APL is almost completely dependent on thermal power and TUC relies on thermal generation for 76% of total capacity. BCH, on the other hand, depends on thermal sources for only 15% of total capacity and, at present, this 15% is used only on an emergency basis. Electrical power is traded freely between Alberta, B.C. and the U.S. Trade between Alberta and B.C. is, however, relatively minor since the only inter-provincial exchange facility (inter-tie) is located at Crows Nest, Alberta and has only a 60 mW transmittal capability.

Both B.C. and Alberta, however, are heavily involved in power sales to the U.S. Virtually all of this power, which goes primarily to the Pacific Northwest and California, is transmitted through the transmission system controlled by the Bonneville Power Authority (BPA).

The primary, in fact the only, market available to a co-generator, however, would be the utility companies in B.C. and Alberta, and an understanding of the basic operation of these companies as related to production, transfer and sale of power is considered essential to an understanding of the market potential for a private power producer. B.C.'s power supply and distribution system is discussed first which, in effect, means a discussion of BCH, the only licensed public supply source.

Until very recently, BCH has shown little or no interest in acquiring co-generated power. The reasons have been mainly technical but the fact that, traditionally, capacity has exceeded demand by a wide margin has also been a key factor in BCH's attitude towards private suppliers. At present, only one co-generating plant using wood-residue is located at Evans Products plywood and sawmill operation at Golden, B.C. Power is sold from this plant to BCH on a fairly consistent basis. Other thermal co-generated power is available to BCH, but the power is utilized only sporadically.

The purchaser of co-generated power in Alberta would be either APL or TUC, depending on site location. In general, TUC services the southern half of the province and APL the northern half. Since Alberta's poplar stands are concentrated in the northern half, APL appears to represent the best market potential.

Both Alberta utilities are very interested in purchasing private power and APL has recently negotiated several contracts with co-generated power suppliers. Details of these contracts are considered confidential but APL has assumed varying degrees of funding responsibility, ranging from constructing and leasing back the generating system to outright ownership and operation of a co-generating plant, with the original owner responsible only for the supply of fuel. To date, none of these contracts involve steady supply from a wood-residue based plant, but APL has indicated a willingness to discuss the possibility with any existing or proposed log processing operation. APL would be prepared to consider providing construction capital on either an equity or debt basis and would be willing to negotiate methods of financing essential auxiliary equipment such as transmission lines and inter-ties. To provide perspective, estimates of the costs of the auxiliary equipment are contained in Appendix 7.

Power supply relationships in the U.S. are similar to those in Alberta. Approximately 77% of the total power demand is provided from thermal generating plants, with less than 10% from hydro sources. The proportions vary by State. For example, in California (a steady market for B.C. & Alberta power) more than 90% of the average demand is supplied from generating sources based on fossil fuels. To reduce this dependency on thermal generation, in particular those based on oil, both the federal and state governments have introduced legislation intended to make co-generated power a more attractive investment option to the private sector. At the federal level, the Public Utilities Regulatory Policy Act, 1978, was introduced which provides the means for reducing or eliminating public utilities regulations in relation to small power producers and co-generators. Additionally, the act requires that electric utilities purchase power from private co-generators at the utilities avoided* or marginal (highest) cost and to sell power to the co-generator, at the regular rates. In other words, a co-generator could sell all of the power generated in the manufacturing process and buy, at a lower rate, all the power required to operate the manufacturing unit. Subsequently, the California Public Utilities Commission issued a decision that established the federal avoided cost guidelines as the mandatory basis for rate negotiation between co-generator and public utility. Partially as a result of these factors, in 1979 approximately sixty co-generating plants were operating in California producing approximately 124 mW of wood-fired electrical capacity. Projects are currently planned which will expand this wood-based co-generation capacity to almost 500 mW by 2000.

Data regarding the degree of wood-based co-generated power provided in Washington, Oregon and Montana are not readily available, but an energy deficit in the region has been predicted to occur** within the next decade. The regional imbalance will undoubtedly be exacerbated by the recent legislative decision to cease construction of five nuclear power plants in the area, each of which was scheduled to provide 1,200 mW capacity. Environmental and budget considerations are stated to be the reasons for cancellations of the plants.

End-Use Markets

Some privately co-generated power from large industrial operations is being used for commercial and residential purposes in communities adjacent to the generating plant. The St. Regis pulp mill at Hinton, Alberta provides power to several commercial organizations in the town. Certain pulp mills in eastern Canada also sell power to nearby communities. The arrangements are very long-standing and originated prior to the availability of public utility power. It is, however, unlikely that any newly developed source of co-generated power would be able to supply markets other than the public utilities. In effect, the public utilities constitute the only market for co-generated power so the markets and trends of power in consumption by industrial sector distributed by the utilities is therefore of interest to this study. Table 73 shows major consuming markets in Canada and the U.S. The trend in Europe is also shown to provide perspective.

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*Avoided or marginal costs are the costs a public utility would have incurred had the utility constructed a new generating facility. In other words, rates would have to be negotiated on the basis of current capital costs and not depreciated capital costs.

**"A Feasibility Study of Wood-Residue Fired Co-generation at Heppner, Oregon" 1979. Columbia Basin Electric Co-op Inc. Bonneville Power Administration. Electric Power Research Institute, Kinzna Corporation.

TABLE 73 MAJOR ELECTRICAL POWER CONSUMING SECTORS

$(\text{kWh} \times 10^9)$

Sector	1975			1979		
	Europe	U.S.	Canada	Europe	U.S.	Canada
Energy	216	420	43	255	380	43
Transportation	33	4	-	38	4	-
Industry	613	646	102	721	828	120
Agriculture	20	32	2	26	36	3
Commercial	172	402	64	221	460	78
Public Service	18	64	2	22	71	2
Residential	349	624	62	442	679	323
Total	1,421	2,192	275	1,725	2,458	323

Source: International Energy Agency, Paris, 1981.

Note: Energy includes activity related to the natural gas, petroleum and electrical generating systems.
Energy for transportation use in Canada is included in the Industry sector.

In all regions, industrial use accounts for the largest proportion, amounting to almost 50% of total use in Europe. Residential use accounts for the next highest proportion, except in Canada where residential and commercial consumption are almost equal. Overall growth rates were 5%, 3% and 4% per annum for Europe, the U.S. and Canada respectively.

The pattern of consumption of power in Alberta and B.C. is similar to that for all Canada but the average per capita consumption varies sharply as shown in Table 74.

TABLE 74 AVERAGE ELECTRICAL ENERGY CONSUMPTION

1980 - 1981

(mWh/Capita)

Region	Consumption
Canada	13.4
British Columbia	15.7
Alberta	9.7

Source: Provincial Public Utility Companies.

Despite the recent strong growth rates in the petro-chemical industry in Alberta, agriculture still constitutes a major portion of the province's total economic output, which probably accounts for the relatively low per capita consumption of electrical energy. Assuming a continued growth in Alberta's industrial base, it seems reasonable to conclude that the demand for electrical power will escalate more rapidly than in B.C. which has established a fairly stable and diverse industrial base. The possibility of this occurring is noted as one of the reasons for the positive attitude of utility companies in Alberta towards the development of capacity for co-generation.

Provincial Regulations

Public utility companies are subject to regulations enacted and enforced by various public utility commissions or authorities. In B.C., the Public Utilities Commission (PUC) is the regulatory body and in Alberta three such bodies are now operative. The first is the Public Utilities Board (PUB), the second is the Electrical Energy Marketing Agency (EEMA) and the third is the Energy Resources Conservation Board (ERCB).

As the senior regulatory agency in Alberta, the PUB acts similarly to the PUC in B.C. and exercises ultimate control over all matters pertaining to electrical power production and distribution. The EEMA, which was created in September, 1982, has been made responsible for ensuring equalization of utility rates throughout Alberta. As a result of this agency's activities, APL has recently instituted rate restructuring which, in effect, amounts to an average rate reduction of approximately 25/30% in areas serviced by APL.

For any potential co-generator, the ERCB, which acts as an advisory and approvals agency for the construction and operation of co-generation plants, would be an important source of information and assistance.

Quality standards, as applied to a co-generator in either province, would only be applicable to the safeguards which the utility companies would insist on at the point where the co-generated power enters the utility's system. If the co-generated electricity is not precisely identical to the utility's electricity in such characteristics as phase, cycle and voltage at the point of entry, very substantial damage to the utility's entire distribution system can result. The techniques and equipment to ensure that the two systems are identical, however, are available but add considerably to the cost of marketing co-generated power.

The same technical restrictions apply whether the co-generated power has been supplied by either hydro, thermal or biomass systems and present no additional disadvantages to a wood-based co-generating plant.

Competitive Products

Wood-based co-generated electricity would have to be competitive with power generated from all other sources, including hydro. Obtaining reliable estimates of the cost of producing electricity by the established methods is extremely difficult because of confidentiality, but more importantly because of the wide age range of the generating plants. This factor is very important because the major portion of operating costs for new plants results from servicing the construction debt load. Generally, fuel costs constitute the next major cost item and labour, overhead and other cost items are relatively minor. Consequently, older, heavily depreciated plants are able to produce power much more cheaply than new plants regardless of the means of power generation.

For this reason, the only meaningful competitive factors for a new power supply source are the established rate structures and the convenience or importance of the additional capacity to a power utility. Rate structures are discussed in detail in a following subsection and, as already noted, utilities in Alberta are more receptive to the concept of co-generated power than the utility in B.C.

Distribution Mechanics

Transmission of electrical power is as complex and costly as power generation and, therefore, it should receive equal attention from a potential co-generator. A factor to be considered therefore in selecting a plant site should be the distance from existing transmission lines if sales of co-generated power are under consideration. Generally, a utility company will not agree to the transfer of power via the utility's transmission circuits to an associated plant or an outside customer, even for a rental or lease fee (generally referred to as a "wheeling charge"). This stricture does not apply between utility companies. Most sales to the U.S. are "wheeled" through the transmission system controlled by the Bonneville Power Administration which delivers the power for a fee but does not set the power charges. The charges are negotiated directly between utility companies. BCH, APL and TUC have established similar inter-tie relationships and power is wheeled between the three utilities on a very flexible basis.

In summary, the transmission of co-generated power would be a critical factor for consideration by any potential new electricity supplier. In addition to the costs of constructing and operating transmission lines, any power supplier faces a formidable array of provincial and federal regulations which would have to be satisfied before any line could be installed. In effect, any co-generator entering the transmission industry would undoubtedly be subject to the same rules and regulations which apply to the public utilities. Except in very unusual circumstances, therefore, plants should be located adjacent to transmission lines and any additional transmission circuits required should be made the responsibility of the utility.

Price Relationships

A public utility's rate structures are complex and non-standard. This applies even within a province such as Alberta. Specifications and conditions governing the sale of power vary between utilities to the extent that precise rate comparisons, based on published rates, are almost impossible to make. This point is illustrated by the data in Table 75 which shows current published rates for APL and TUC.

TABLE 75 ELECTRIC POWER RATES, ALBERTA POWER LIMITED AND TRANSALTA UTILITY CORPORATION, DECEMBER 1981

TUC Demand	Rate	APL Demand	Rate
First 500 kW	$11.25/kW	First 300kW	$16.20/kW
Next 2000 kW	8.25/kW	Next 700kW	8.90/kW
Over 2500 kW	6.40/kW	Over 1,000kW	3.63/kW
Energy			
First 400 kWh	1.17¢/kWh		3.65¢/kWh
Over 400 kWh	0.66¢/kWh		2.03¢/kWh

Source: Utilities' Published Rate Schedules.

The above rates should be taken as order-of-magnitude only. Actual industrial negotiations could produce rate structures markedly different from those in Table 75. Many factors, such as responsibility for funding and operating the necessary transformers and other equipment, would influence final rates. The rates shown, however, are considered reasonably applicable and provide a basis for comparison with 1982 B.C. Hydro's rates shown in Table 76.

TABLE 76

B.C. HYDRO PUBLISHED ELECTRICAL RATES, DECEMBER 1982

(Schedule 1200 - 25 kW Service)

Demand (Monthly Charge)	Rate
First 35 kW	Nil
Next 115 kW	$2.40/kW
Excess over 115 kW	$4.60/kW
Energy	
First 275 kWh	5.30¢/kWh
Next 6725 kWh	3.80¢/kWh
Next 23000 kWh	2.70¢/kWh
All Additional kWh	1.60¢/kWh

Source: BCH, Published Rates.

A reasonably accurate comparison of the cost effect of the various rate schedules can best be made by applying the rates to a hypothetical plant. Table 77 shows the actual electrical power costs for a hypothetical sawmill with a maximum demand of 7000 kW, operating 15 hours per day, 20 days per month.

TABLE 77 ESTIMATED ELECTRICAL POWER CHARGES

B.C. & ALBERTA

($ per month)

	Monthly Demand Charge	Monthly Energy Charge	Total Monthly Charge
B.C. Hydro	$ 31,786	$ 38,245	$ 70,031
Transalta	50,925	26,208	77,133
Alberta Power	32,870*	81,760*	80,241*

*A 30% equalization rebate is applied to the demand and energy components. Thus: (1 - 0.3) ($32,870 + $81,760) = 0.7 ($114,630) = $80,241.

Source: Rate schedules for the utility companies; applied by CHI to a hypothetical 7000 kW plant.

To develop the costs shown in Table 77, many assumptions were made and the actual rate applications would be subject to conditions and provisions which have been ignored for the purposes of this study. The charges shown, however, are considered to be valid as comparisons between the three utilities and to provide perspective in relation to the price at which utilities are willing to purchase co-generated power. BCH has issued a schedule of co-generation purchase rates which establishes a buying rate of 1.86267¢/kWh. It is apparent that this rate is substantially lower than the average rates developed in Table 77. Neither TUC nor APL have published co-generation purchase rates and the existing contract rates are considered to be confidential.

It is apparent that a more detailed site-specific analysis would have to be made before any rational decision could be taken regarding production of co-generated power in any forest-related operation.

Trade Inhibitors

Beyond rate negotiations and the constraints imposed by technical considerations, there are no obstacles to electrical power trading between public utilities. As noted, a limit on trade between B.C. and Alberta is imposed by the single existing exchange facility but trade with the U.S. is limited only by the practicalities of internal or local supply and demand.

It is unlikely that any co-generator would either effect, or be affected by, changes in the established trade patterns since the amount of power supplied to any utility would be relatively insignificant.

Future Demand

BCH is presently revising demand forecasts and final projections have not yet been finalized. Electrical demand forecasts originally published by BCH indicated an average annual growth rate of approximately 6%. However, subsequent projections developed in 1981/82 have reduced this considerably, with the lowest being approximating 3.5% per annum.

Although demand forecasts are not available from APL, the rate of growth is expected to be similar to that anticipated for Transalta and this growth rate is shown in Table 78.

TABLE 78

DEMAND GROWTH FORECAST, TRANSALTA UTILITY CORPORATION

Year	Annual Increase
1982	9%
1983	9.1%
1984	12.9%
1985	8.3%
1986	9.3%
1987	6.2%
1988	4.1%
1989	4.3%
1990	3.2%

Source: Transalta Utility Corporation.

Despite the uncertainties involved in long-range forecasting, it is apparent that, even if the projections shown in Table 78 are extremely high, the increase in demand would still be substantial. Under current projections, demand in Alberta will almost double by 1990.

BCH anticipates that under present conditions a substantial power surplus will exist until 1987, at which point proposals from private co-generators would receive very serious consideration.

In summary, over the long-term, unless major declines in industrial growth occur in B.C. and Alberta, the demand for electrical power will increase at a very high rate, placing severe pressure on governments and public utilities to increase capacity substantially.

Conclusions and Recommendations

Although the techniques for converting forest biomass and/or log processing residue into electrical energy have been available for many years, it was not until the advent of escalating energy costs in the early 1970's that the process offered the potential for economic power generation.

For a number of technical reasons, public utilities have been reluctant to enter into contractual arrangements with private co-generators, but growing energy demand, increasing thermal generation costs and, in the case of B.C., the increasing complexity of new hydro generating capacity, have all tended to make utility companies more receptive to purchase private power. Alberta public utilities, in particular, appear willing to not only purchase power but also to assist in funding the development of co-generated power supplies.

Production and sale of electrical power should only be considered if the power available is in excess of the energy demand of a related manufacturing facility. In other words, only co-generated power should be considered and the production and marketing of co-generated power should be included in the feasibility study for any poplar-based industrial development. The sale of excess power offers not only the opportunity to increase the financial return to any development, but also provides the opportunity for economically utilizing the substantial volumes of residue normally associated with poplar processing.

Various methods for efficiently converting wood residue to heat energy have been developed.

Specific recommendations:

1. The potential co-generator should explore the availability of funding that the Federal Government has allocated for research and development in the production of gaseous and liquid fuels from biomass feedstocks. While the "Forest Industry Renewable Energy" program (FIRE) was devised to promote conversions from oil to biomass, a prospective co-generator should examine this source of funds.

2. In view of the vast area covered by the poplar forests, the location of a plant with co-generating capacity must take into account many factors including road-rail transportation, services and water availability, waste disposal, environmental factors and the distance from the potential site to the nearest public utility intertie.

3. Contact with Alberta's utility companies revealed a strong interest in direct involvement, either with capital or a lease-back arrangement in co-generation plants provided the economic feasibility and security of supply were assured. APL, which relies basically on thermal power sources, and has a transmission system somewhat accessible to the poplar forest regions indicated a particular interest.

4. Sale to other industrial customers in the vicinity of a co-generation plant has distinct advantages, providing no utility power is available to those customers.

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32-214	Feed Industry
35-001	Construction Type Plywood
35-002	Production, Shipments, Stocks in Sawmills East of the Rockies
35-003	Production, Shipments, Stocks in Sawmills in B.C.
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APPENDIX I

ABBREVIATIONS AND DEFINITIONS

ABBREVIATIONS AND DEFINITIONS

APL	Alberta Power Limited
ACSR	"Aluminum Conductor Steel Reinforced" Power Cables
ANPA	American Newspaper Publishers Association
API	American Paper Institute
AFNOR	Association Francais Pour Normalisation
BPA	Bonneville Power Authority
B.C.	British Columbia
BCH	British Columbia Hydro and Power Authority
CD	Calender Days
CDX	Exterior Sheathing Plywood - U.S. Grade Terminology
CHMC	Canada Housing and Mortgage Corporation
CIP	Canadian International Paper Ltd.
CPPA	Canadian Pulp and Paper Association
CSP	Canadian Softwood Plywood
CSF	Canadian Standard Freeness
CSA	Canadian Standards Association
CHI	Carroll-Hatch (International) Ltd.
CMP	Chemi-mechanical Pulp
C.I.F./cif	Cost Including Insurance and Freight
CIC	Crown Investments Corporation of Saskatchewan
cum	cubic metres
DRI	Data Resources Inc.
DIN	Deutsche Industrie Normen (W. Germany)

DIY	Do It Yourself
ECP	Edmonton City Power
EEMA	Electrical Energy Marketing Agency; (Alberta)
ERCB	Energy Resources Conservation Board; (Alberta)
EEC	European Economic Community
EFTA	European Free Trade Area
FAO	Food and Agricultural Organization of the United Nations
FAO/IWP	Food and Agricultural Organization/Industry Working Party
FAS	Free Along Side
fbm	foot board measure
FMT	Finished Metric Ton
GATT	General Agreement on Tariff and Trade
g/cc	grams per cubic centimetre
GDP	Gross Domestic Product
GNP	Gross National Product
gsm	grams per square metre
IMF	International Monetary Fund
km	Kilometre
kVa	Kilo-Volt-Amps (apparent power)
kWh	Kilowatt Hours (Consumption)
LVL	Laminated Veneer Lumber
M.D. Charge	Maximum Demand Charge
MDF	Medium Density Fibreboard
mW	Megawatts (Power)
mt	Million tonnes
n/a	not available

nes	not elsewhere specified
NORSCAN	The United States, Canada, Sweden, Norway, Finland
n.o.p.	not otherwise provided for
NTIS	National Technical Information Service (Washington, D.C.)
OECD	Organization for Economic Cooperation and Development
OEM	Original Equipment Manufacturer
OSB	Oriented Strand Board
PB	Particleboard
PUB	Public Utilities Board; (Alberta)
PUC	Public Utilities Commission; (B.C.)
PURPA	Public Utilities Regulatory Policy Act (U.S.)
Q	Quarter
RMP	Refiner Mechanical Pulp
SCP	Single Cell Protein
S/C	Supercalendered
SGW	Stone Groundwood Pulp
sm	Square Metre
SPF	Spruce/Pine/Fir
SRI	Stanford Research Institute
SWE	Solid Wood Equivalent
S2S	Surfaced two sides
t	metric tonne
TDN	Totally Digestible Nutrient
TMP	Thermomechanical Pulp
tpa	metric tons per annum
TUC	Transalta Utilities Corporation

U.N.	United Nations
U.S.	United States
USDA	United States Department of Agriculture
WB	Waferboard
WFPL	Western Forest Products Laboratory

MONETARY UNITS	US$	United States Dollar
	C$	Canadian Dollar
	S$	Singapore Dollar
	HK$	Hong Kong Dollar
	NT$	New Taiwan Dollar

APPENDIX 2

HARDWOOD LUMBER GRADING RULES

APPENDIX 2

Hardwood Grading Rules

The specifications shown here are reproduced from the grading rules issued by the U.S. National Hardwood Lumber Association. In general, the rules are accepted universally.

POPLAR

Note: Mineral stain not exceeding in the aggregate one-sixth of the surface of the piece is admitted in Firsts and Seconds and on the face side of Selects. It is not limited in Saps and in the Common grades.

FIRSTS: Standard, except:
Widths: 8" and wider.
SECONDS: Standard, except:

Pieces of 4' and 5' surface measure shall yield not less than 11/12 (91 2/3%) clear face in one cutting; pieces 6' and 7' surface measure shall yield not less than 11/12 (91 2/3%) clear face in not over two cuttings.

SAPS: Widths: 5" and wider. There is no restriction in the amount of heartwood or sapwood.

Lengths: 8' to 16', admitting 30% 8' to 11'.

Pieces 5" wide shall be clear except that one split not exceeding in length the width of the piece, or its equivalent is admitted.

Pieces 6" and wider may have wane along the edges not exceeding 1" in width, one-sixth the length and one-half the thickness of the piece, or its equivalent in area at one or both ends and a split not exceeding in length the width of the piece, or its equivalent, which shall not be considered defects. In addition pieces 6" to 9" wide admit one standard defect; 10" and wider two standard defects, or their equivalent, except that in pieces 6" to 8" wide such standard defect shall not be wane or split.

Side bend shall be limited to 1/2" in pieces 8' and 9' long; 3/4" in 10' to 12' and 1 1/4" in 13' to 16'. Each additional 1/2" of side bend shall be considered as one additional standard defect.

SELECTS: Standard, except:
Widths" 6" and wider.
Lengths: 8' to 16', admitting 30% 8' to 11' of which one-half may be 8' and 9'.

Selects shall grade not below Seconds Poplar on one face, and not below No. 1 Common Poplar on the reverse side; the reverse side of the cuttings in both FAS and No. 1 Common are not required to be sound.

STAINED SAPS: This grade is the same as Saps except that stain is admitted.

NO. 1 COMMON: Standard, except slight stain is admitted.

Lengths: 6' to 16', 10% of which may be 6' and 7'.

NO. 2A COMMON: Standard No. 2 Common, except stain is admitted.

NO. 2B COMMON: Standard No. 2 Common, except stain is admitted, and cuttings to be sound as defined in "Sound Cutting".

NO. 3A COMMON: Standard, except stain is admitted and cuttings to be sound as defined in "Sound Cutting".

NO. 3B COMMON: Standard.

APPENDIX 3

PRODUCTION OF FURNITURE COMPONENTS

APPENDIX 3

Production of Furniture Components

Successful servicing of the furniture industry depends on the ability to convert poplar logs into lumber efficiently and to provide the furniture industry with correctly - sized material. A recent survey of the furniture and cabinet industries carried out by the Northeastern Forest Experiment Station, U.S. Forest Service* determined that at least 5,000 different sizes are in demand. For a primary lumber producer to supply even a small fraction economically would be almost impossible and, therefore, the study team developed the concept of producing standard size "blanks" from which furniture producers could, without excessive waste, produce the finished furniture component. The sizes and quality of these "blanks" are shown in Table 79. Dimensions are shown in the units and in the analysis since these relate directly to the units used in the second part of the project; i.e. efficient processing of low-quality hardwood logs.

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*Research Paper NE-494.

TABLE 79

RECOMMENDED HARDWOOD BLANK STANDARD SIZES FOR FURNITURE AND CABINET MANUFACTURERS

(inches)

Nominal Thickness	Intended Product Finish Thickness	Actual Blank Thickness	Blank Lengths												
Clear Quality/26-inch Wide Blanks															
5/8	3/8	1/2	13	15	17	18	22	26	31	36	42				
3/4	1/2	5/8	14	17	19	22	25	29	31	35	41	47	58	86	
4/4	3/4	7/8	15	18	21	25	29	33	38	45	50	60	75	100	
1-1/4	1	1-1/8	15	18	21	25	29	33	38	45	50	60	75	100	
1-1/2	1-1/4	1-3/8	15	18	21	25	28	32	35	40	45	50	60	70	85
2	1-5/8	1-3/4	15	18	21	25	28	32	35	40	45	50	60	70	90
Core Quality/26-inch Wide Blanks															
1	3/4	7/8	15	18	21	23	26	29	34	40	50	60	70	95	
1-1/4	1	1-1/8	15	18	21	23	26	29	34	40	50	60	70	85	
Sound Frame Quality (for upholstered frames)/20-inch Wide Blanks															
1	3/4	7/8	13	17	19	22	24	27	29	33	44	54	70	80	100
1-1/4	1	1-1/8	15	18	20	23	25	28	33	45	55	65	80	90	100
1-1/2	1-1/4	1-3/8	14	18	21	24	28	31	34	40					
2	1-5/8	1-3/4	12	16	19	21	24	28	30	34					
Sound Interior Quality (for case goods)/20-inch Wide Blanks															
1	3/4	7/8	15	18	21	25	29	34	40	50	60	70	95		

Based on the results of the very extensive survey conducted by the U.S. Forest Service, the above array of sizes provides the scope to service a major portion of the furniture and cabinet industries with material which will allow production of finished components within a maximum of 10% waste.

In conjunction with the development of the blank concept, the Northeastern Forest Experimental Station has developed a system for efficiently processing low-quality, small-diameter logs into lumber. The lumber is then further manufactured into the appropriate blank size. After extensive research and numerous trials a pilot plant to test the concepts developed for efficient production of lumber was constructed in 1980 and has been operating on a semi-commercial basis ever since. The system and plant details are contained in a report titled "New Technology for Low-Grade Hardwood Utilization - System 6" published by the U.S. Forest Service in 1981.

A summary of the steps in the "System 6" process follows:

1. Divide the low-grade hardwood resource into different roundwood products. For western poplar this means segregating excessively crooked or decayed logs from those intended for processing into lumber.

   The criteria established for the pilot plant are:

Maximum lengths:	6 feet and 8 feet
Sweep (Maximum)	1 1/2 inches all diameters
Diameter:	8 through 12 inches
Quality:	Sound and Solid. Sound defects without limit.

2. Cut System 6 bolts to two-sided cants, not lumber.
   A method for producing cants efficiently is outlined in the report.

3. Use automated cant sawing to make boards.
   A method for re-sawing boards only from the cants (and side-cuts) is suggested and provision is made for processing crooked or warped cants.

4. Use described drying practice.
   Drying is a particularly important step in producing poplar lumber and the procedure developed for System 6 should be carefully evaluated.

5. Remove the majority of defects with automated cut-up.
   Most of the boards produced to this point would probably be of low-quality with most natural defects still present. A method for eliminating defects efficiently has been developed for System 6 processing which would probably be compatible with poplar's characteristics.

6. Where necessary, bring pieces to specified size and quality with manual cut-up. Under the methods used in System 6 approximately 20% of the pieces produced to this stage require manual finishing. The remaining 80% requires no further cutting.

7. Make standard-size blanks as the final products of the system. Procedures for matching and glue-jointing the separate pieces into selected blank sizes have been incorporated for the final step in the process.

The summary of the system included in the report is reproduced here.

"System 6 will require modified procedures all the way from the tree to the furniture rough mill. For greatest efficiency, tree-length logs should be bucked to multiple products including System 6 bolts, pallet bolts, pulp bolts, and firewood. System 6 bolts will be sawed to two-sided cants to aid in the release of growth stresses and to control the width of boards that will be gang-sawed from the cants. A maximum board width of 4 inches is recommended. Boards from cants must be dried immediately. Once properly dried, they will be converted into blanks of specified length, width, thickness, and quality.

The economics of System 6 has been covered elsewhere (Reynolds and Gatchell 1979: Gatchell and Reynolds 1980). There appears to be a sufficient economic potential at each step from trees to standard blanks. In addition, there are opportunities for secondary products: slabwood from the sawmill, rejected boards and slabwood from the cant gang saw, edgings, and trimmings from the kiln-dried boards, and green and dry sawdust - all available for use as fuel or as inexpensive raw material for further processing."

The system described (or an adaptation thereof) offers one possible solution to the problem of recovering high-quality furniture stock from low-quality trees. Undoubtedly, other methods could be developed, but a logical approach would be to utilize the pilot plant facilities and methods to process samples of the type of log to be expected from commercial logging of Alberta's and B.C.'s poplar resource. It is probable that adjustments to the proposed system would have to be made, particularly regarding production of the cants which may be difficult because of centre-rot which is a feature of western poplar stands.

Other characteristics of poplar, besides shape and size, were noted during interviews as undesirable and would also require investigation. One of these mentioned frequently was discoloration which was noted as a drawback to poplar's acceptance as a valuable furniture wood. Difficulty in obtaining an acceptable "finish" on poplar was mentioned many times and research into methods for finishing poplar readily should be made a part of any research program undertaken.

In summary, to process poplar logs into lumber successfully will undoubtedly require cutting and handling techniques compatible with poplar's natural characteristics. These techniques have been developed but should be carefully assessed prior to adoption in B.C. or Alberta.

APPENDIX 4

ESTIMATED WORLD PRODUCTION AND SHIPMENTS OF WOOD-BASED PANELS 1970, 1975, 1980

TABLE 80

ESTIMATED WORLD PRODUCTION AND SHIPMENTS OF WOOD-BASED PANELS

(thousand cum)

	1970 Plywood & Blockboard				1970 Particleboard				1970 Fibreboard			
	Prod'n	Exp	Imp	Cons	Prod'n	Exp	Imp	Cons	Prod'n	Exp	Imp	Cons
Africa - Total	306	127	97	276	169	10	21	180	134	71	66	129
Cent.America-Total	147	69	69	216	16	22	9	3	66	-	8	74
S.America Total	579	44	6	541	311	11	9	309	331	45	11	297
Rep. of China	794	-	-	794	30	-	-	30	188	1	-	187
Hong Kong	10	1	47	56	-	-	-	-	-	-	6	6
India	128	10	-	118	12	-	-	12	30	6	-	24
Indonesia	7	-	2	9	-	-	-	-	1	-	-	1
Japan	6,922	322	255	6,855	350	-	17	367	707	2	3	708
S.Korea	847	822	-	25	24	2	-	22	7	-	-	7
Malaysia	197	144	5	48	1	-	-	1	-	-	13	13
Philippines	653	261	-	392	-	-	-	-	-	-	-	-
Singapore	215	132	56	139	-	-	1	1	52	4	4	52
Asia Total	10,063	2,342	457	8,178	597	15	27	609	1,076	13	63	1,126
EEC Total	1,890	338	1,771	3,323	7,902	1,184	1,414	8,132	1,131	299	1,261	2,093

Exp - exports
Imp - imports
Cons - consumption

ESTIMATED WORLD PRODUCTION AND SHIPMENTS OF
WOOD-BASED PANELS

(thousand cum)

	1970 Plywood & Blockboard				1970 Particleboard				1970 Fibreboard			
	Prod'n	Exp	Imp	Cons	Prod'n	Exp	Imp	Cons	Prod'n	Exp	Imp	Cons
Scandinavia Total	805	610	98	293	980	308	78	750	1,651	918	7	70
Other Europe	1,234	211	191	1,214	3,418	349	414	3,483	1,416	335	301	1,382
Europe Total	3,929	1,159	2,060	4,830	12,300	1,841	1,906	12,365	4,198	1,562	1,569	4,215
U.S.S.R	2,045	231	56	1,870	1,994	145	-	1,849	1,359	139	-	1,220
Australia	108	1	37	144	264	3	1	262	192	46	6	152
N.Zealand	52	6	2	48	53	2	-	51	76	8	-	68
S.Pac.Total	176	19	47	204	318	5	3	316	268	55	28	241
Mexico	96	1	6	101	56	-	-	56	21	1	2	22
U.S.A.	14,078	115	1,771	15,734	3,127	21	12	3,118	5,821	95	283	6,009
Canada	1,851	369	131	1,613	283	-	40	323	934	92	36	878
N.America Total	16,025	485	1,908	17,448	3,466	21	52	3,497	6,776	188	321	6,909
WORLD TOTAL	33,174	4,472	4,700	-	19,170	2,048	2,020	-	14,207	2,062	2,067	-

TABLE 81

ESTIMATED WORLD PRODUCTION AND SHIPMENTS OF WOOD-BASED PANELS

(thousand cum)

	1975 Plywood & Blockboard				1975 Particleboard				1975 Fibreboard			
	Prod'n	Exp	Imp	Cons	Prod'n	Exp	Imp	Cons	Prod'n	Exp	Imp	Cons
Africa Total	386	95	163	384	249	4	46	291	167	58	72	181
Cen.America Total	173	18	85	240	30	-	7	37	66	-	7	73
Argentina	61	-	-	61	209	-	-	209	51	8	-	43
Brazil	660	-	-	660	407	1	-	407	504	112	-	392
South America Total	939	45	21	915	707	13	-	694	590	120	2	472
Rep. of China	1,023	768	-	255	43	-	-	43	261	-	-	261
Hong Kong	12	1	68	79	-	-	-	-	-	-	3	3
India	127	15	-	112	11	-	-	11	25	3	-	22
Indonesia	104	1	7	110	-	-	-	-	1	-	-	1
Japan	6,168	116	148	6,200	699	-	4	703	497	4	-	493
S. Korea	1,436	1,258	-	178	52	-	-	52	16	6	-	10
Malaysia	404	233	4	175	-	-	-	-	-	-	22	22
Philippines	423	157	-	266	17	-	-	17	62	-	1	63
Singapore	334	380	140	94	-	-	-	-	-	6	13	7
Asia Total	10,301	2,969	589	7,921	1,176	162	115	1,129	1,078	21	78	1,135
EEC Total	1,571	430	1,793	2,934	11,709	2,018	2,568	12,259	1,024	296	942	1,670

ESTIMATED WORLD PRODUCTION AND SHIPMENTS OF WOOD-BASED PANELS

(thousand cum)

	1975 Plywood & Blockboard				1975 Particleboard				1975 Fibreboard			
	Prod'n	Exp	Imp	Cons	Prod'n	Exp	Imp	Cons	Prod'n	Exp	Imp	Cons
Scandinavia Total	537	371	109	431	1,912	719	104	1,297	1,285	522	10	773
Other Europe	1,430	215	215	1,430	5,452	815	770	5,407	1,883	343	383	1,923
Europe Total	3,538	1,016	2,117	4,639	19,073	3,552	3,442	18,963	4,192	1,161	1,335	4,366
U.S.S.R.	2,196	303	46	1,939	3,994	274	-	3,720	2,617	241	-	2,376
Australia	78	-	57	135	379	13	19	385	153	36	-	127
New Zealand	43	-	5	48	128	2	2	128	88	3	-	85
S. Pacific Total	141	2	70	209	507	15	22	514	241	39	6	208
Mexico	10	-	16	26	125	-	7	132	14	2	-	12
U.S.A.	14,579	514	1,674	15,739	4,190	179	70	4,081	6,236	169	108	6,175
Canada	2,051	313	622	2,370	566	143	174	597	764	49	72	787
N. America Total	16,640	827	2,312	18,125	4,881	322	251	4,810	7,014	220	180	6,974
World Total	34,313	5,287	5,402	-	30,618	4,342	3,883	-	15,882	1,860	1,681	-

TABLE 82

ESTIMATED WORLD PRODUCTION AND SHIPMENTS OF WOOD-BASED PANELS

(thousand cum)

	1980 Plywood & Blockboard				1980 Particleboard				1980 Fibreboard			
	Prod'n	Exp	Imp	Cons	Prod'n	Exp	Imp	Cons	Prod'n	Exp	Imp	Cons
Africa Total	433	81	221	573	372	2	77	447	81	24	100	157
Cent. America Total	1,067	25	121	1,163	55	-	109	164	66	1	8	73
Argentina	53	-	5	58	248	1	n/a	247	84	11	5	78
Brazil	762	116	1	647	550	3	n/a	547	755	147	-	608
South America Total	1,080	189	8	899	948	29	n/a	919	921	186	5	740
Rep. of China	1,563	1,240	9	332	43	-	1	44	461	-	-	461
Hong Kong	12	1	237	248	-	-	4	4	-	-	20	20
India	180	7	-	173	21	-	-	21	32	1	-	31
Indonesia	525	253	2	274	-	-	-	-	1	2	-	-
Japan	8,400	48	50	8,402	950	1	75	1,024	570	6	-	564
S. Korea	1,575	946	-	629	45	21	-	24	13	-	-	13
Malaysia	490	474	22	38	2	3	-	1	-	-	21	21
Philippines	553	361	-	192	n/a	5	-	n/a	69	-	-	69
Singapore	482	616	248	114	-	6	25	19	-	10	21	11
Asia Total	14,258	3,983	1,182	11,457	1,726	49	210	1,887	1,289	24	98	1,363
EEC Total	1,588	612	2,634	3,610	13,135	2,359	3,963	14,739	969	286	1,081	1,764

ESTIMATED WORLD PRODUCTION AND SHIPMENTS OF WOOD-BASED PANELS

(thousand cum)

	1980 Plywood & Blockboard				1980 Particleboard				1980 Fibreboard			
	Prod'n	Exp	Imp	Cons	Prod'n	Exp	Imp	Cons	Prod'n	Exp	Imp	Cons
Scandinavia Total	727	549	185	363	2,361	904	131	1,588	1,189	459	19	749
Other Europe	1,300	309	228	1,219	8,523	1,558	619	7,584	2,367	557	316	2,126
Europe Total	3,615	1,470	3,047	5,192	24,019	4,821	4,713	23,911	4,525	1,302	1,416	4,639
U.S.S.R.	1,988	-	-	1,988	4,695	267	-	4,428	3,008	303	-	2,705
Australia	87	1	63	149	622	16	-	606	110	6	2	106
New Zealand	42	28	2	16	121	68	2	55	136	19	-	117
S. Pacific Total	146	36	74	184	743	83	5	665	246	25	6	227
Mexico	350	14	5	341	415	-	14	429	35	2	-	33
U.S.A.	15,000	248	1,001	15,753	6,100	227	538	6,411	5,619	200	183	5,602
Canada	2,338	548	81	1,871	1,257	415	50	892	723	67	71	727
N. America Total	17,688	810	1,087	17,965	7,772	642	502	7,632	6,677	269	254	6,662
World Total	40,275	6,908	5,789	39,156	40,330	5,480	5,615	40,465	16,514	2,133	1,887	16,268

Source: FAO Yearbook of Forest Products, 1980
Numbers do not always add due to rounding.
Deficiencies in some country data reconciled from CHI file data.

APPENDIX 5

CANADA, ESTIMATED ANNUAL AVERAGE SHIPMENTS OF WOOD-BASED PANELS COMPARED TO CAPACITY

APPENDIX 5

CANADA
ESTIMATED AVERAGE ANNUAL SHIPMENTS OF WOOD-BASED PANELS COMPARED TO CAPACITY

(thousand cum)

	Average Shipments 1981-1986	Capacity 1983
Waferboard		
Domestic	471,000	
Export - U.S.A.	208,000	
Export - Other	15,000	
Total	694,000	1,280,000
Particleboard		
Domestic	750,000	
Exports (Mainly U.S.A.)	150,000	
Total	900,000	1,180,000
MDF		
Domestic*	70,000	-
Hardboard		
Domestic	180,000	
Exports	25,000	
Total	205,000	235,000
Rigid Insulating Board		
Domestic	400,000	
Exports	50,000	
Total	450,000	930,000
Poplar Plywood		
Domestic	65,000	
Exports	5,000	
Total	70,000	100,000

*All imported.

APPENDIX 6

AVERAGE ANNUAL HOUSING REQUIREMENTS BY TENURE, DWELLING TYPE AND HOUSING TYPE, CANADA, 1976-2001

APPENDIX 6

AVERAGE ANNUAL HOUSING REQUIREMENTS BY TENDURE, DWELLING TYPE AND HOUSHOLD TYPE, CANADA, 1976-2001

(thousands of units)

Tenure	1976-81	%	1986-86	%	1986-91	%	1991-96	%	1996-2001	%
Homeowners	118.5	53	123.6	59	117.4	65	93.9	71	72.6	74
Rental	104.0	47	86.6	41	64.0	35	37.7	29	26.0	26
Total	222.5		210.2		181.4		131.6		98.6	
Dwelling Type										
Single	108.8	49	112.9	54	106.2	59	86.1	64	66.3	67
Semi-Detached	9.6	4	9.4	4	8.0	4	5.0	4	2.7	3
Row Houses	7.2	3	64.6	31	49.4	27	31.5	24	23.2	24
Apartments	77.5	35	64.6	31	49.4	27	31.5	24	23.2	24
All Other Types	19.4	9	16.3	8	12.3	7	7.4	6	5.5	5
Total	222.5		210.2		181.4		131.6		98.6	
Household Type										
Family	142.3	64	135.7	65	118.0	65	84.5	64	58.0	59
Non-Family	80.2	36	74.5	35	63.4	35	47.1	36	40.6	41
Total	222.5		210.2		181.4		131.6		98.6	

Source: "The Demographic Future: Impacts on the Demand for Housing in Canada, 1981-2001", Canada Mortgage and Housing Corporation, July 1981

APPENDIX 7

TARIFF SCHEDULES - SELECTED COUNTRIES AND ITEMS

APPENDIX 7

TARIFF SCHEDULES

Note: For the U.S.A., EEC and Japan, which were signatories to the GATT agreement of 1980, many of the tariffs were scheduled to be reduced in stages as follows:

The tariff rates agreed upon by each participant were, except as otherwise specified in its' schedule, implemented in equal annual stages beginning on January 1, 1980. The total reduction will become effective on January 1, 1987. A participant which began its reductions on July 1, 1980 would, unless otherwise specified, make effective two-eights of the total reduction on that date, followed by six equal annual instalments beginning on January 1, 1982. The reduced rate at each stage is to be rounded off to the first decimal. Countries may implement reductions in fewer stages or at earlier dates than those indicated if they choose to.

TARIFF SCHEDULES - UNITED STATES OF AMERICA

Selected Items of Interest to Canada

Tariff Schedule Item	Brief Description	Base Rate %	Final Rate %
202.54	Lumber, wood siding, drilled/ treated, other	5	Free
202.66	Wood moldings, etc., other	8.5	4.5
240.00	Veneers, birch/maple, not reinforced, backed	4	Free
240.03	Veneers, other, not reinforced, backed	5	Free
240.14	Plywood, birch	7.5	3
240.15	Plywood, softwood	20.0	See note
245.20	Hardboard, over $96.67 per short ton	7.5	3
245.50	Particleboard, waferboard	10	4%*

*The rate in 1983 is 7.0%.

Note re softwood plywood:

Canada's settlement on softwood plywood with the United States envisages the development of common North American plywood standards. To provide time for the work envisaged, no tariff cuts on either side will be initiated until 1983, and tariff reduction will be dependent on both governments being satisfied with the progress being made in the development of such standards. The settlement provides for tariffs to be reduced and harmonized at 8 percent, from 15 percent in Canada and 20 percent in the United States, if the above agreement is reached.

However, at time of writing (July, 1983), there has been no such agreement.

TARIFF SCHEDULES - JAPAN

Selected Items of Interest to Canada

Item No.	Description	Base Rate % (1979)	Final Rate %
44.05-310	Lumber of spruce, pine of fir	10.0	6.0**
44.11-330	Hardboard and fibre building boards	22.5	6.5
44.13-300	Wood planed - tongued etc. of spruce, pine, fir, softwood	10.0	-
44.15-111	Plywood - tongued, grooved or worked, nes	20.0	15.0**
44.15-191	Plywood - faces plies both sides of softwood	15.0	-
44.15-194(195)	Plywood - other than softwood, not less than 6mm	20.0	17.0**
44.18	Reconstituted wood agglomerated with natural or artificial resins (includes waferboard)		
	- in sheets or boards	20.0	12.0
	- other	15.0	10.0
44.23-090	Builders carpentry and joinery, nes	7.5	4.9
44.28-290	Other articles of wood, nes	10.0	5.8

Note:

**Tariff reductions will start from 1984.

"nes" - not elsewhere specified.

TARIFF SCHEDULES - EUROPEAN ECONOMIC COMMUNITY

Selected Items of Interest to Canada

Item No.	Description	Base Rate %	Final Rate %
44.13	Planed Lumber	5	4
44.14	Veneers	7	6
44.15	Plywood, softwood within special quota	See note re "free entry"	
44.15	Plywood, other than in the quota and hardwood	13	10
44.18	Particleboard, waferboard	12	10

Note: "Free" entry for softwood plywood into EEC member countries means coniferous plywood from any supplier, e.g., Canada, U.S.A., Sweden, etc., may enter without duty up to the level of an annual quota, established by the EEC at a minimum of 600,000 cum, but which generally ranges up to 700,000 cum. The share of the total annual quota varies within individual member countries and is specific to the following thicknesses and types of plywood:

(a) coniferous plywood, unsanded, thicker than 8.5 mm.

(b) coniferous plywood, sanded, thicker than 18.5 mm.

Coniferous plywoods less than the above thicknesses in each type would face the standard duty of 12 percent (1983).

TARIFF SCHEDULES - KOREA
CHAPTER 44 BTN CLASSIFICATION

Selected Items of Interest to Canada.

The Republic of Korea applies a general tariff - not a GATT schedule.

Item No.	Description	Tariff Rate %
23.00	Animal Fodders	
23.02	Bran - various types	20
	Oilcake (incl. soya)	20
	Rapeseed	20
Note:	Import of prepared, pre-mixed animal feeds is prohibited. All mixing must be done in Korea.	
27.00	Mineral fuels, oils	
27.07	Benzene, Toluene, Xylene	10
	Naptha	10
27.09	Crude petroleum oil	5
	Crude oil from bituminous material	5
27.11	Methane, propane, butane, etc.	10
29.00	Hydrocarbons (generally all)	20
29.01	Ethylene, propylene	10
	Toluene	10
29.04	Methanol	20
29.06	Phenols	20
	Acetone	20
29.14	Acetic acid	20
30.00	Pharmaceuticals (generally)	40
44.01	Fuelwood, sawdust	5
44.03	Pulpwood, wood in rough	5
	Sawlogs, veneer logs, coniferous	5
	Sawlogs, veneer logs, non-coniferous, tropical	5
	Sawlogs, veneer logs, non-coniferous, temperate	5

Item No.	Description	Tariff Rate %
44.04	Wood roughly squared or half squared but not further manufactured - tropical	10
	Wood roughly squared or half squared but not further manufactured - temperate	0
44.05	Wood sawn, sliced or peeled but not further prepared - thickness greater than 5 mm. Other than coniferous	20
44.07	RR sleepers	20
44.09	Pickets, stakes, pulpwood in chips or particles	5
44.11	Fibreboard	20
44.14	Wood sawn, sliced or peeled, not greater than 5 mm thick, coniferous	30
	Veneer sheets - tropical or other	30
44.15	Plywood - all types of finishes and types, overlaid etc.	30
	Block board	30
44.17	Reconstituted wood, chipboard	30
44.19	Mouldings	30
44.21	Packing cases	50
44.22	Casks, barrels	50
44.23	Joinery and pre-fabricated buildings	40
44.25	Wooden tools, handles	40
47.01	Mechanical wood pulp	10
	Chemical wood pulp	10
	Chemical wood pulp unbleached	10
	Sulphites, others	10
48.01	Newsprint - kraft, paper	40
	Kraft liner board, all weights	40
48.17	Miscellaneous papers, paperboards	25
48.21	Labels, cards, etc.	50

TARIFF SCHEDULES - TAIWAN
CHAPTER 44 BTN CLASSIFICATION

Selected items of interest to Canada.

Item No.		Description	Tariff Rate %	
			I	II*
4403		Wood in the rough, whether or not stripped of its bark or merely roughed down.		
	02.00	(1) Sawlogs and veneer logs, of coniferous species	Free	
		(2) Sawlogs and veneer logs, of non-coniferous species		
	03.10	(a) Aspen, poplar, cotton-wood, lime	Free	
	03.20	(b) Teak free		
	03.30	(c) Lauan, ramin	Free	
4404		Wood, roughly squared or half-squared, but not further manufactured.		
	01.00	(1) Of coniferous species	Free	
	02.00	(2) Of non-coniferous species	Free	
4405		Wood sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm.		
		(1) Of coniferous species		
	01.10	(a) Laths	15	10
	01.90	(b) Other (as ordinarily manufactured)	15	10
	02.10	(2) Of non-coniferous species		
		(a) Laths	15	10
	02.20	(b) Teak-wood (beams, planks)	15	10
	02.90	(c) Other (as ordinarily manufactured)	15	10
4407	00.00	Railway or tramway sleepers of wood.	10	7.5

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*Imports from Canada, U.S., Australia, New Zealand, Indonesia, Japan, Malaysia, Republic of Korea, enter under column II rate, otherwise column I.

Item No.		Description	Tariff Rate % I	Tariff Rate % II*
4409		Hoopwood; split poles; piles, pickets and stakes of wood, pointed but not sawn lengthwise; chipwood; drawn wood; pulpwood in chips or particles; wood shavings of a kind suitable for use in the manufacture of vinegar or for the clarification of liquids; wooden sticks, roughly trimmed but not turned, bent or otherwise worked, suitable for the manufacture of walking-sticks, umbrella handles, tool handles or the like.		
	01.00	(1) Wood chips	Free	
	99.00	(2) Other	35	25
4411		Fibre building board of wood or other vegetable material, whether or not bonded with natural or artificial resins or with other organic binders.		
	01.00	(1) Bagasse shaving board	40	30
	99.00	(2) Other	40	30
4412	01.20	Sandal wood flour, oil extracted.	NT$5/Kg	
	99.00	Other		25
4413	00.00	Wood (including blocks, strips and friezes for parquet or wood block flooring, not assembled), planed, tongued, grooved, rebated, chamfered, V-jointed, centre V-jointed, beaded, centre-beaded or the like, but not further manufactured.	40	25
4414		Wood sawn lengthwise, sliced or peeled but not further prepared, of a thickness not exceeding 5 mm; veneer sheets and sheets for plywood, of a thickness not exceeding 5 mm.		
	01.00	(1) Wood sawn lengthwise, sliced or peeled but not further prepared, of a thickness not exceeding 5 mm	40	25
	99.00	(2) Other	40	25
4415		Plywood, blockboard, laminboard, battenboard and similar laminated wood products (including veneered panels and sheets); inlaid wood and wood marquetry.		
	01.00	(1) Plywood, blockboard, laminboard, battenboard and similar laminated wood products	45	40
	02.00	(2) Veneer panels and sheets	45	40
	03.00	(3) Inlaid wood and wood marquetry	45	40

Item No.		Description	Tariff Rate %	
			I	II*
4416	00.00	Cellular wood panels, whether or not faced with base metal.	45	40
4417		"Improved" wood, in sheets, blocks or the like.		
	01.00	(1) Blocks for making shuttles (specific gravity: over 1; dimensions: not over 500 mm in length, 70 mm in width and 50 mm in thickness)	20	
	99.00	(2) Other	50	40
4418	00.00	Reconstituted wood, being wood shavings, wood chips, sawdust, wood flour or other ligneous waste agglomerated with natural or artificial resins or other organic binding substances, in sheets, blocks or the like.	50	40
4419	00.00	Wooden beadings and mouldings, including moulded skirting and other moulded boards.	50	40
4420	00.00	Wooden picture frames, photograph frames, mirror frames and the like.	50	40
4424	00.00	Household utensils of wood.	50	40
4421	00.00	Complete wooden packing cases, boxes, crates, drums and similar packings.	60	40
4422		Casks, barrels, vats, tubs, buckets and other coopers' products and parts thereof, of wood, including staves.		
	01.00	(1) Staves	35	
	99.00	(2) Other	60	40
4423	00.00	Builders' carpentry and joinery (including prefabricated and sectional buildings and assembled parquet flooring panels).	50	40
4425	00.00	Wooden tools, tool bodies, tool handles, broom and brush bodies and handles; boot and shoe lasts and trees, of wood.	50	40
4426		Spools, caps, bobbins, sewing thread reels and the like, of turned wood.		
	01.00	(1) Bobbins and the like for textile machinery use	30	
	99.00	(2) Other	50	40

Item No.		Description	Tariff Rate % I	II*
4427		Standard lamps, table lamps and other lighting fittings, of wood; articles of furniture, of wood, not falling within Chapter 94; caskets, cigarette boxes, trays, fruit bowls, ornaments and other fancy articles, of wood; cases.		
	02.00	Articles of furnitures of wood, not falling within Chapter 94.	65	

Notes:

(1) In this Chapter, the expression "improved wood" means wood which has been subjected to chemical or physical treatment (being, in the case of layers bonded together, treatment in excess of that needed to ensure a good bond), and which has thereby acquired increased density or hardness together with improved mechanical strength or resistance to chemical or electrical agencies.

(2) Headings nos. 4419 to 4427 are to be taken to apply to articles of the respective descriptions of fibre building board, plywood, cellular wood, "improved" wood or reconstituted wood as they apply to such articles of wood.

(3) Heading no. 4425 shall be taken not to apply to tools in which metal parts form the blade, working edge, working surface or other working part.

TARIFF SCHEDULES - CANADA

Selected Items

Tariff Item Number	Description	Base Rate of Duty% (Applied Rate)	Concession Rate of Duty%
-	Tarred paper and prepared roofings (including shingles), fibreboard, strawboard, sheathing and insulation, manufactured wholly or in part of vegetable fibres, n.o.p.; blotting paper, not printed nor illustrated:		
19200-1	Other than the following (MDF included in this item).	15	9.2
19200-2	Building papers and building paper felts, whether or not coated or saturated, not cut-to-size or shape; fibreboard, strawboard, sheathing and insulation, manufactured wholly or in part of vegetable fibres, n.o.p., not cut-to-size or shape; blotting paper, not printed nor illustrated, not cut-to-size or shape.	15	6.5
19200-3	Hardboard, unfinished.	15	6.5
19200-4	Hardboard, n.o.p.	15	9.2
50060-1	Timber or lumber of hardwood (the wood of any deciduous species of tree), drilled but not otherwise further manufactured than the product of a planing machine with various profile attachments or not further manufactured than matched or patterned on a matching machine, sticker or moulder.	5	Free
50600-3	Cellular panels, whether or not face finished; waferboard.	15	4 (1)
50600-4	Wood windows.	15	12.5

Tariff Item Number	Description	Base Rate of Duty (Applied Rate)	Concession Rate of Duty
50600-6	Rough blanks or blocks of wood, not edge-glued nor otherwise manufactured.	15	Free
50600-8	Mouldings of wood, having more than one profile.	15	6.8
50600-9	Softwood plywood, face finished.	15	8 (2)
50600-10	Plywood, face finished, n.o.p.	15	8
50600-11	Wood panels, veneer on one side; laminated building boards.	15	8
50600-12	Particleboard.	15	4 (1)
50705-1	Single-ply, sliced or rotary-cut veneers of wood, n.o.p., not over five-sixteenths of an inch in thickness, not taped nor jointed.	7.5	Free(3)
50710-1	Veneers of wood of any kind, not over five-sixteenths of an inch in thickness, taped or jointed.	10	Free(3)
	Plywood:		
50715-1	Other than the following.	15	8
50715-3	Plywood of okoume.	10	8
50715-4	Softwood plywood; plywood with a face veneer of softwood.	15	8 (2)
50725-1	Plywood faced with metal on one or both sides.	15	9.2

(1) Concession to be implemented in eleven annual stages beginning January 1, 1980.

(2) Implementation of concession to United States plywood to commence on January 1, 1983 conditional on satisfactory progress in development of common North American standards for softwood plywood. (See note under Tariffs - U.S.)

(3) Concession to be implemented in three annual stages beginning January 1, 1980.

In addition to these tariffs, Canada permits entry of some products from "emerging" nations under the General System of Preferences at further reduced tariffs. Plywoods and other wood products from most of the southeast Asian area, excepting Japan, are included in this system.

APPENDIX 8

SUMMARY OF B.C. AND ALBERTA UTILITIES

APPENDIX 8

Summary of Transmission Circuit Cost Estimates

B.C. HYDRO

a) 1981 - 82 peak - 5,902 mW (increase of 7.8%)
Virtually 100% hydro generation

b) System capacity
7,491 mW Hydro
1,347 mW thermal (negligible use 1981-82)

8,838 mW Total

Annual kWh Output

	1981-82	1981	1982
Domestic sales (90% of B.C.'s Population)	$28,295 \times 10^6$	$27,589 \times 10^6$	$26,246 \times 10^6$
Surplus Export	$6,984 \times 10^6$		
Line loss & system use	$3,971 \times 10^6$		
Total Generation	$39,250 \times 10^6$		

Includes thermal 192×10^6
Includes purchases $1,219 \times 10^6$ (co-generation - 1 account 5.6×10^6 kWh)

Average usage per residential customer increased from 9,001 (1980-81) to 9,413 (1981-82)

New customers	1981 - 82	30,780
New customers forecast	1982 - 83	37,500

Revenues 1981 - 82 increased 27% to $\$1,124 \times 10^6$ including $\$233 \times 10^6$ of export sales.

One co-generation contract contributed approximately 5.6×10^6 kWh @2.2¢/kWh

Total number of electricity accounts - March 1982 - 1,076,926

TRANSALTA UTILITIES CORPORATION

Generating Capacity:

Thermal:	2,556mW +377 under construction (coal fired)
Hydro:	800mW
	3,356mW Total (on-line)
System peak:	2,587mW (1981 - 82) 2,755mW (1982 - 83 Forecast)
Number of accounts:	265,000 Direct 560,000 In-Direct (sales to co-ops)

Annual kWh Output:

	1980	1981	1982
Annual kWh (Domestic Sales)	12,820 gWh	13,854 gWh	15,100 gWh
Export	Nil	Nil	Nil
Losses	1,167	1,120	1,285
	13,987	14,974	16,384

Co-generation Purchases Nil

Growth Forecast

1980	1981	1982	1983	1984
8.7%	8.1%	9%	9.1%	12.9%
1985	**1986**	**1987**	**1988**	**1989**
8.3%	9.3%	6.2%	4.1%	4.3%
1990				
3.2%				

Transalta Utilities supplies Lethbridge, Red Deer, Calgary and inter-ties to Edmonton.

ALBERTA POWER LIMITED

Generating Capacity

Thermal:	1,055 mW
Hydro:	2,000 mW
	3,055 mW (Total (on line)
Under construction:	
Thermal	375 mW (1985) 375 mW (1986)
System peak:	651.7 mW (1982) 537 mW (1981)
Number of accounts:	150,000 +

Annual kWh Output:

	1980	1981	1982
Domestic sales	3,027,313	3,711,192	+7% forecast
Export	Nil	Nil	Nil
Losses	n/a	n/a	n/a

Co-generation purchases - Not available.

Growth forecast - Not available

TRANSMISSION CIRCUIT COST ESTIMATE

Transmission circuit capital costs from a co-generating plant to the utility transmission network can vary to a large degree based on:

a) Length of line.
b) Terrain conditions.
c) Remoteness - transportation and housing.
d) Construction period - weather.

Estimate

1. 69kV 266 ACSR transmission tie - ideal terrain
   50 mW capacity - wood pole-flat construction
   Min. cost $75,000 to $100,000/km (including materials, labour, survey, minimum clearing, but no land costs).

2. Similarly 240kV "H" frame construction towers, conductor 927 ACSR
   Cost: $125,000 - 150,000/km

3. Co-generation Plant - Transmission Line Terminal Substation - 1982
   a) 25mW Station - 69kV
      1 transformer
      2 - Oil Circuit Breakers
      Dead end structure
      All civil - foundations, fencing, gates (no land value included).
      Total cost: $12,000,000

   b) 25 mW Station - 240 kV
      Same equipment and assumptions as above
      Cost: $20,000,000

These costs include field supervision, engineering and contingency surcharge.

Source: B.C. Hydro

APPENDIX 9

SUMMARY OF RATES, COSTS AND CO-GENERATION CONTRACTS

APPENDIX 9

Summary of Rates, Costs & Co-generation Contracts

B.C. Hydro

In November 1982 B.C. Hydro (BCH) set the price to be offered to customers who wish to sell surplus electricity to them at the energy cost of the last step of the appropriate filed rate schedule, with the proviso that they may curtail or interrupt purchases when such energy cannot be sold or stored.

The new policy means the offered purchase price for co-generated electricity has risen substantially and will increase with future rate changes. The new rate was adopted to encourage co-generation and other alternative forms of private generation. This purchase price does not include any "marginal pricing component" at this time.

Currently BCH forecasts indicate a surplus of energy from their sources until 1987 or later which would preclude the signing of new private source contracts for the interim.

Any contract currently in effect would be subject to cut-off in the event of the necessity to spill from a BCH reservoir. Under the current Public Utilities Act the sale of co-generated power is limited to the sale to tenants or employees of the co-generating plant, otherwise the sale of surplus energy is declared subject to PUC regulations and permits are required from the PUC or Minister of Energy to sell power. That is, a co-generation source cannot sell to a community unless it is declared a utility by the Public Utilities Commission.

The currently franchised utility could conceivably assume ownership of a town-site distribution system and supply power under standard rates, coupled with a purchase agreement from the co-generating plant, with or without a transmission tie to the utilities grid.

Basically a co-generating plant would ideally supply electricity, hot water and/or steam to satisfy the base industry and sell the balance of heat and electricity to ancillary industries and/or a town site in the immediate area.

BCH would be prepared to discuss contractual purchases, with delivery after 1987, of co-generated energy from a proposed project in order to allow design and financing to proceed. Such a supply to BCH would entail the construction of a "step-up" substation at the supplying plant to a transmission voltage compatible with the utility's system plus construction of a transmission circuit to a specific location on the system.

Substation costs and transmission costs for this tie could be substantial and are indicated in Appendix 7.

The electrical protection of the substation must be satisfactory to the utility. A liability provision would likely be incorporated in the purchase agreement to cover indemnity in the event of damage sustained by the receiving utility.

BCH's present policy on a co-generated energy purchase for loads 5 to 20 mW is as follows: (Ref. Appendix 9 for rate structures)

A) Loads Over 5000kW

Energy Purchase (kWh) Filed Transmission Rate Schedule 1821 + Schedule 1899 - "Water Rental Adjustment Fee"

ie.	Schedule 1821 energy	1.5387	cents/kWh
	Schedule 1899 Rental Fee	.32397	
		1.86267	cents/kWh

B) Loads under 5,000kW

Schedule 1211: 1.689 + 11 1/2% (interim increase 1 April 1982) + .314 (water rental) = 2.197235 cents/kWh

Based on information from BCH the B.C. PUC has not indicated to date that pricing be established on "avoided costs" of new generation.

Under a provision of the Public Utilities Regulatory Policy Act (PURPA) in the U.S. and supposedly now applicable in California the "purchasing utility" is required to pay the co-generator the "avoided cost" ie. the generating capacity component as well as a commodity charge.

BCH is not prepared to purchase generating capacity at this time at avoided costs. Offerings of co-generated power exceeding 20 mW to BCH are subject to a negotiated commodity charge.

Standby Power

Currently BCH is prepared to offer a standby contract on the following basis:
Maximum Demand Charge - 10% of Schedule 1821 M.D. charge ($3.345/kVA)
ie. $4.014/kVA paid annually (standby charge only)
plus Schedule 1899 water rental surcharge - (.078 x 1.115) + .237 = .32397 cents/kWh

On Delivery

An energy charge and demand charge yet to be determined will be applied.
+10% over Schedule 1821 commodity and demand charges. (subject to a minimum of three days on agreed delivery).

Billing on Schedule 1821 in this manner is designed to provide an incentive to the consumer to upgrade his plant to reduce demand and consumption.

Emergency Power (on request)

BCH is also considering a rate approximately double the maximum demand charge and commodity charge on Schedule 1821 if no standby contract is in effect for the specific customer.

Alberta

The transmission networks of Transalta Utilities Corporation (Calgary Power), Alberta Power Limited, and the Cities of Edmonton and Calgary are inter-connected through transmission ties. Edmonton has its own generation supplemented by supplies from Alberta Power and Transalta.

Transalta Utilities Corporation interfaces with the BCH transmission grid with a 138 kV tie at Crows Nest. The inter tie has limited capability of approximately 90 to 100 mW including roughly 30 mW of BCH-supplied Kootenay mining load. B.C. and Alberta transmission grid maps are attached in the Appendix.

Regulatory Bodies

1. Public Utilities Board
   Has yet to address its views on co-generation.

2. Electrical Energy Marketing Agency
   (Formed September 1, 1982)
   The agencies function is to average utility rates in Alberta. Alberta Power (Canadian Utilities) rates have already been lowered. Rate application processing is presented to the Marketing Agency and then to the Utilities Board.

3. "Energy Resources Conservation Board"
   Approves co-generation and thermal generation plants.

1. Alberta Power Limited

   The rate department contacts in the above utility advise that 3 or 4 co-generated supply contracts have been negotiated both as to rates and terms and conditions of supply. Currently Alberta Power is in the process of addressing co-generation possibilities.

   Alberta Power in respect to a co-generation purchase contract is very interested in investing capital in the generating plant as well as providing or participating in the transmission tie and associated substation(s). Aside from a firm base load supply from an industrial plant Alberta Power will also accept electricity supply excess imbalance from such a generation source.

   One such contract involves a purchase - sale agreement covering the plus-minus requirements of a 60 mW plant supplied at 240 kV from the utility.

   This particular plant comprises 6 boilers and 2 turbines with a generating output of 260 mW.

Incorporated in the agreement is a "standby provision" (filed with the Public Utilities Board) to supply up to 100 mW at 240 kV at a rate of 25 mils per kWh (includes a maximum demand charge component). This supply is contingent on voltage - Vars limitations on the system at the particular time.

The transmission upgrading cost for the 138 kV to 240 kV was paid for by the customer on a fixed carrying charge basis (no lump sum payment). Alberta Power owns the transmission line plus the terminal substations supplying the two 75 kV plant feeder circuits.

Generally such agreement for loads greater than 30 mW are negotiated contracts and those less than 30 mW are at published rates for firm supply. No interruptible contractual agreements apply at less than 30 mW.

Another co-generation contract applies to an electricity supply source from a Forest Industry customer operation on energy imbalance and supplying all excess electricity to Alberta Power.

In another such contract a customer leases a generation plant owned by Alberta Power with the private plant supplying fuel for the generation.

Another Petroleum product operation has a provision in its purchase agreement to supply power to the Alberta Power grid but current plant electrical requirements exceed the plants own generating capacity.

Alberta Power prefers to tie such supplementary sources to the transmission grid at the highest voltage ie. 72 kV and above for system stability.

Private plant electricity sources are of particular interest to Alberta Power because 99% of Alberta Power's generation is thermal (oil - natural gas - coal).

System output is in the order of 1055 mW.

Alberta Power Limited's coal thermal plant now under construction with a capacity of 2 units of 375mW each is scheduled to be on-line in 1985-86. This plant is also located at a coal mine site. Bus bar generation costs are estimated at 3.4¢ per kWh in 1985 dollars.

2. Transalta Utilities Corporation

Transalta's generation consists of 13 hydro installations on the Bow River with a generation capacity of 800 mW.

In addition, thermal plants account for approximately 2556 mW of generation. The B.C. Hydro 138 kW inter-tie is capable of approximately 60 mW.

Transalta Utilities Corp. advised that their new coal-fired thermal plant bus bar generation costs are expected to be 3¢/kWh. This plant has 2-400mW units scheduled for operation in 1983-84 at an estimated cost of $860/kW of capacity. The thermal plant and coal mine are located on the same site.

a) Co-generation

Transalta has one co-generation contract for a relatively small load from a natural-gas fired thermal installation.

Transalta is also looking into co-generation purchase contracts and their rates department has indicated that co-generation rates will be established. Currently the market possibilities are considered quite minimal.

No rate structures or contracts have been established for firm co-generation power purchases to date. It appears however that the recently formed "Energy Resources Conservation Board" may require a co-generator selling to a utility to be paid "avoided costs" if the plant load factor (eg. 75%) matches that of the utilities thermal plant generation. That is, the purchasing utility should pay for the generation capacity cost otherwise avoided.

Reliability of the customer's plant vs. utility plant may influence generation capacity pricing.

b) Standby Contracts

Rate is based on gas turbine generation at $2.60/kW month plus the standard rate for energy delivered.

c) Wheeling Charge Policy

Applies to inter-utility transfers only.

U.S.

Pacific Northwest Power's rates have been recently increased to compensate for financing costs for those utilities delaying construction of nuclear - thermal generation.

The U.S. Public Utilities Regulatory Policies Act - (PURPA) has decreed that "avoided costs" (ie. the marginal or highest cost) related to new generation must be paid to producers of co-generated power. However, it appears that California may have been considering applying some leverage on utilities by forcing rate application deferments if a certain percentage of offered co-generation was not contracted. The utilities normal rate structures are based on an average generation plant costing. The PURPA also removed wheeling charge restrictions which hindered some projects in the past.

An anomolous situation can arise under PURPA regulations in as much as the co-generator may sell at the utilities marginal cost offering price while simultaneously purchasing plant process power at the utilities' standard rates.

Generally, prevailing utility rates lag behind marginal costing thus the co-generator secures an economic benefit. The incentive to negotiate a wheeling charge is diminished in this situation and should not be an economic advantage.

Currently Bonneville has agreed to pay 35 mils and others in the BPA 50-60 mils as a "avoided cost" component.

Rate Examples

Pacific Power and Light-Portland
(one year contract)
    Co-generation "Firm" power 1.72¢/kWh
    + $5.16/kW mos.

    Non-Firm Power 1.60¢/kWh
    No capacity charge.

From 1989 if:
a) 25 year life in contract remaining
   $10.29/kW capacity charge
   8.79¢ commodity charge

b) if 4 - 5 year life in contract remaining:
   Commodity charge variable down to 1.65¢/kWh

In California, evidently, 60-70 mil "avoided costs" are common.

APPENDIX 10

COMPARISON OF POWER COSTS - B.C. AND ALBERTA

APPENDIX 10

Comparison of Power Costs - B.C. and Alberta

Assumptions:

Power consumption kW	7,000
Hours per shift	8
Hours per day	16
Days per month	20
Operating hrs./month (20 days x 16 hr./day)	320
kW hrs./month (7000 kW x 320 hr./mo.)	2,240,000
Supply service kV	25

B.C. Hydro Charges

Demand

First 35 kW	Nil
Next 115 kW x $2.40	$ 276.00
Next 6,850 kW x $4.60	31,510.00
Sub-Total Demand	$ 31,786.00

Energy

First 275 kWh x $.05389/kWh	$ 14.82
Next 6,725 kWh x $.03889/kWh	261.54
Next 23,000 kWh x $.02789/kWh	641.47
Remainder 2,210,000 kWh x $.01689/kWh	37,326.90
Sub-Total Energy	$ 38,244.73
Total Monthly Electrical Power Costs	$ 70,030.73

Transalta Utility

Demand

First 500 kW x $11.25/kW	$ 5,625.00
Next 2,000 kW x $8.25/kW	16,500.00
Remainder 4,500 kW x $6.40/kW	28,800.00
Sub-Total Demand	$ 50,925.00

Energy

First 400 kWh/kW x .0117/kWh x 7000 kW = $32,760.00
For 2,240,000 kWh x $32,760/400kWh/7000kW = $26,208.00

Sub-Total Energy	$ 26,208.00
Total Monthly Electrical Power Costs	$ 77,133.00

Alberta Power

Demand

First 300 kW x $16.20	$ 4,860.00
Next 700 kW x $8.90	6,230.00
Remainder 6,000 kW x $3.63/kW	21,780.00
Sub-Total Demand	$ 32,870.00

Energy

First 400 kWh x 7,000kW x $.0365/kWh = $102,200.00
For 2,240,000 kWh x $102,200/400 kWh/7000kW = $81,760.00

Sub-Total Energy	$ 81,760.00
Total Electrical Charges/Month - Gross	114,630.00
Less 30% equalization rebate	34,389.00
Total Monthly Electrical Power Costs	$ 80,241.00

Transalta Utilities Corporation

Rate Schedule 790

Maximum Demand	first 500 kW	11.25/kW mos.
	next 2000 kW	8.55/kW mos.
Excess over 2500 kW		6.40/kW mos.
Energy 400 kWM/kW		1.17¢
Excess		.66¢

Discounts

Customer owned transformation	40¢/kW
Interruptible contract	80¢/kW mos.
Off-peak (5-9 pm Mon-Fri) Nov. - Feb. Incl.	75% of high maximum dem. off peak period 105% if high max demand "on peak"

Note: A large customer (unspecified as to delivered voltage or load) could have a combined firm - interruptible contract.

Standby Rate

$2.60/kW month. Rider over and above standard rate contract.

Alberta Power Limited
Industrial Rate Schedule

1. 25kV source - up to 15 MW

Maximum demand first 300 kW	$4,859.00
Next 700kW	8.90/kW
Excess over 1,000 kW	3.63/kW

Energy

First 400 kWh/kW of demand	3.65¢
Excess	2.03¢

Surcharges - power factor less than 90%
- Rate equalization 3.643% on monthly bill
  (temporary to offset revenue short fall)

Interim Rebate to customer
30% of calculated bill including 3.643% surcharge plus 5% for income tax on face amount of billing.

2. 69kV source - to 30MW maximum
   - Special contract over 30 MW

Maximum demand
1000kW $10.737
Excess maximum demand $3.29/kW

Energy 400 kWh/kW 3.43¢
Excess 1.9¢

3. Standby rate (filed with the Public Utilities Commission)
   $12.10 per kW
   Plus net energy "in" per hour at 1.67¢ per kWh
   Discounted 30% on billing (marketing agency rate equilization)

APPENDIX II

B.C. HYDRO CO-GENERATION PURCHASE RATES

APPENDIX 11

B.C. Hydro Co-generation Purchase Rates

Schedule 1821

Commodity Charge	Per kWh	1.5387
Water Rental	.078	
+		
Rate Adjustment PUC	.237	
+		
Rate Interim Increase (From April 1/82)	11.5%	
i.e. .078 (1.115) + .237 =		.32397
Commodity Purchase Price		1.86267¢/kWh

No marginal cost component included at this time.

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